

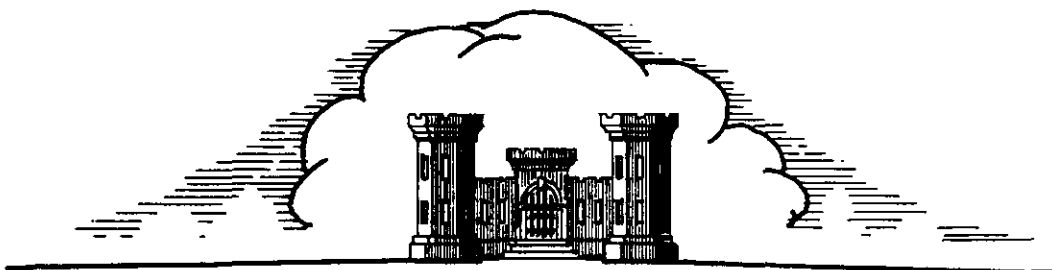
CONNECTICUT RIVER FLOOD CONTROL PROJECT

KEENEY LANE PUMPING STATION

CONNECTICUT RIVER
HARTFORD, CONN.

ANALYSIS OF DESIGN

ITEM HT.11—CONTRACT



WAR DEPARTMENT CORPS OF ENGINEERS U. S. ARMY
U. S. ENGINEER OFFICE PROVIDENCE, R. I.

JULY 1944

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I. INTRODUCTION

I. INTRODUCTION.

A. AUTHORIZATION AND PAST REPORTS. - The Keeney Lane Pumping Station is a part of the local protection works for the City of Hartford, as recommended by the District Engineer in "Report of Survey and Comprehensive Plan for Flood Control in the Connecticut River Valley", dated March 20, 1937, approved by the Chief of Engineers, November 29, 1937, and published as House Document No. 455, 76th Congress, 2nd session. The project is authorized under the Flood Control Act approved June 28, 1938.

B. DESCRIPTION OF EXISTING SEWAGE SYSTEM AND PUMPING FACILITIES. - Originally the municipal sewers serving the area between Morgan Street and Park River discharged directly into the Connecticut River. In addition the Park River interceptor sewer was equipped with overflows through which storm flow was discharged into the Park River. Other sewers, such as the Gully Brook Interceptors, also discharged into the Park River.

A pumping station, known as the Potter Street Station, was constructed in 1916 for the purpose of dewatering the area between Morgan Street and Park River during high stages of the Connecticut River.

Upon completion of the sewage disposal plant in South Meadows, the practice of discharging sewage into the Connecticut and Park Rivers was discontinued. Two small sewage pumps were installed in the Potter Street Station and all normal sewage flow was pumped to the disposal plant by way of the Commerce Street Sewer. During high stages of the

Connecticut River all sewage treatment was discontinued and both sewage and storm flow were pumped into the river by a small pumping station located at the disposal plant and by the Potter Street Pumping Station.

C. NECESSITY FOR THE NEW STATION. - The construction of the Hartford Riverfront Dike and the Park River Conduit will prevent the natural drainage of an area in excess of 600 acres in reaching the Connecticut River during high stages. Adequate pumping facilities must therefore be provided. The existing sewer facilities are such that the construction of one large station which would serve the entire area will not be possible without extensive reconstruction of the sewers. It has been found that the most economical solution of the problems will be the construction of two stations, which nevertheless will necessitate some reconstruction of existing sewers and construction of one new intercepting sewer. Thus the above-mentioned area of 600 acres will be divided into two drainage areas, of which one consisting of 256 acres will be served by the two main sewers, Park River interceptor and the East Side interceptor, which terminate at the Commerce Street sewer near the Potter Street Pumping Station. The other drainage area, about 230 acres, will be served by the upper reaches of the same Park River interceptor; a gate will be installed near Main Street and a new pumping station, the Bushnell Park Station, will be constructed near Hudson Street. The remainder of the original drainage area will be served by the recently constructed North Meadows Pumping Station. (See Plate No. 1). A study of the drainage area (256 acres) tributary to the Potter Street Station and an examination of the existing pumping station facilities show that the existing pumping station is inadequate. The station cannot operate above elevation 30 m.s.l. and for stages below this elevation, the

existing pumps can handle only a portion of the estimated inflow. The building is in a deteriorated condition and there is insufficient space for larger pumps. A new pumping station, therefore, will have to be constructed. Simultaneous or independent operation of the existing Potter Street and the proposed Keeney Lane Pumping Stations will be possible for some time in the future and a diversion chamber will be constructed at such a location that flow can be directed to either station. When the Potter Street Pumping Station eventually becomes obsolete, the Keeney Lane Station alone will serve the drainage area. Therefore, the capacity of the new station will be large enough to prevent the accumulation of storm water and sewage behind the dike and flood wall and the resulting damage to property.

The war emergency precluded the construction of a permanent pumping station in the fall of 1943. However, a temporary pumping station was constructed to provide partial flood protection to the vital war industries located in the drainage area. This temporary pumping station consists of a concrete substructure, a concrete diversion chamber, a volute pump made available from North Meadows Pumping Station and a wooden superstructure. The permanent pumping station will use and enlarge the concrete substructure of the temporary pumping station, but the wooden superstructure will be demolished.

D. CONSULTATION WITH THE CITY OF HARTFORD. - During the design of the pumping station, consultations were held with officials representing the City of Hartford and the Flood Commission of Hartford. The proposed station layouts were studied by them, and in conference, the relative merits of the layouts proposed and the equipment to be used were discussed in detail. It was agreed that special mechanical features would

be incorporated in the design with the understanding that the City would pay for the increase in cost from the funds contributed by the City to cover local costs. The pumping station design as finally developed meets with the approval of the Flood Commission of the City of Hartford.

E. BRIEF DESCRIPTION OF THE STATION. - The pumping station will consist of a reinforced concrete substructure utilizing and enlarging the existing reinforced concrete substructure and a one story superstructure of structural steel and brick with glass block panels to serve as windows. The concrete roof slab will be covered with a built-up type roof of four-ply asphalt and gravel. The engine room on the ground floor will contain three gasoline engines and right angle gear units for the 36-inch pumps, the **DIESEL** motor for the 16-inch pump, the standby unit, the overhead crane and other equipment. The substructure will be divided into the intake chamber, suction conduit, pump room, and discharge conduit. The intake chamber will contain the mechanically cleaned trash racks which were requested and the added cost thereof borne by the City of Hartford. Gates will be installed in the intake chamber to keep it dry during periods when no pumping will be required. In the pump room there will be installed three 36-inch volute pumps, one 16-inch volute pump and two sump pumps. The discharge conduit will be connected to the existing pressure conduit which extends under the dike to the Connecticut River. The discharge conduit will be provided with a gate which will be open during periods of gravity flow and closed when pumping will be necessary. On the intermediate floor there will be located the heating equipment room and the operational room for the mechanically cleaned racks.

II. SELECTION OF THE SITE.

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The pumping station will be located on the north side of Keeney Lane and approximately 60 feet from the existing Potter Street Station, which is located across the street between Keeney Lane and Potter Street. This location was chosen for the following principal reasons: first, it is the lowest point in the drainage area; second, this location allows a direct outflow line through the existing conduit to the Connecticut River; third, the existing temporary pumping station, built during the war emergency at this site, may be utilized in the permanent structure.

III. SOILS INVESTIGATIONS AND FOUNDATIONS.

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Foundation conditions were determined by one 2-1/2" bore hole (BH-263) and one 3-1/2" bore hole (BH-278) located at site of proposed station and two additional 2-1/2" bore holes located approximately along outlet conduit from pumping station. Dry drive samples were taken in all bore holes. Graphic logs and locations of these explorations are shown on a soil profile and plan on Plate No. 4 (CT-2-1390). Numbers on boring logs are those of the Providence Soil Classification described on above noted plate and shown graphically on Plate No. 5 (S.L. Form 91).

Weight of pumping station will about equal that of soil excavated and since station is founded on sand only minor settlement is expected.

Normal water table will vary between El. 5₊ to El. 12₊. Major foundation problem is prevention of disturbance to foundation soil by water seeping upward into excavation during construction. For this positive means of water control will be required.

This pumping station will be constructed after the war when construction materials are not critical. To eliminate undermining the present pumping station due to seepage of ground water into the excavation for this construction work, Wakefield wood sheet piling was installed on the west edge of the present foundation slab. This increases the seepage path and thus reduces the seepage velocity when it enters the excavation.

IV. HYDROLOGY.

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A. DRAINAGE AREA. - The Keeney Lane Pumping Station will serve a tributary drainage area of 256 acres which extends along the bank of the Connecticut River in Hartford, Connecticut, from Park River on the south to some distance north of the railroad freight yards, and is bounded on the west by Main Street. The area is relatively flat, ranging in elevation from approximately 25 to 60 feet above mean sea level.

1. Present conditions. - The area is fully developed by industrial and commercial interests.

2. Possible future conditions. - It is not expected that any future development in this area will materially increase either the drainage area contributing to the pumping station or the rate of run-off from the area.

B. SEWER FACILITIES.

1. Existing sewers. - The entire area is provided with a sewer system which drains to the present Potter Street Pumping Station of the City of Hartford and the temporary Keeney Lane Pumping Station. The existing sewer layout is shown on Plate 3.

2. Existing pumping stations. - The existing Potter Street Pumping Station of the City of Hartford has two electrically driven 12-inch pumps which handle sewage flow only, and three electrically driven 24-inch pumps for storm water flow. The temporary Keeney Lane Pumping Station has one 36" pump driven by a gasoline engine. At the present time there are two concrete outlets from these stations to the river, a 6'-0" square conduit from the temporary Keeney Lane Station and a 7-foot 6-inch circular conduit from the Potter Street Station. The two 12-inch

sewage pumps pump sewage flow from the East Side Interceptor, through a force main in Potter Street, into the Connecticut River Interceptor in Commerce Street (a sewage line which flows to the South Meadows sewage treatment plant). When the Connecticut River is high, the storm water flow in both the East Side Interceptor and the Park River Interceptor is pumped to the river by the three storm water pumps. The capacity of these pumps falls off rapidly at heads corresponding to river elevations above 30 m.s.l. Because of the obsolescence, worn condition, and poor operating characteristics of the pumps, the Potter Street Station is considered inadequate for interior drainage of the Connecticut River dike project. The presence of this station may, however, be regarded as an added factor of safety in the over-all drainage scheme.

3. Future development. - It is improbable that any future changes in the existing sewer system will greatly increase the rate of run-off from the drainage area. The Keenoy Lane Pumping Station will be located on Keenoy Lane opposite the existing Potter Street Station. During flood stages it will pump the combined sanitary and storm drainage from its tributary area, shown on Plate No. 1, into the Connecticut River.

4. Time of concentration. - A study of the drainage system of the area shows that the probable time of concentration at the pumping station would be one hour.

C. SEEPAGE. - The foundation underlying the dike is of varying permeability. Seepage through the pervious formation will be prevented by a sheet pile cut-off. Because of the character of the design, the quantity of seepage to be expected through the dike and its foundation at maximum head will be small.

D. STORAGE. - Natural surface storage is negligible and it is not feasible to create a basin for storage of peak flows from the tributary area which is urban in character.

V. DETERMINATION OF DISCHARGE CAPACITY.

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A. REQUIREMENTS FOR DISCHARGE CAPACITY. - The Keenoy Lane Pumping Station will be of sufficient capacity to meet the following requirements:

1. Discharge the storm run-off from the total tributary drainage area. Design criteria are as follows:

a. Runoff caused by a 1-hour storm (time of concentration of this area is approximately 1 hour) with a probable frequency of occurrence of once in 10 years, occurring in any month, when pumping against a river stage with a probable frequency of occurrence of once in 10 years for that month.

b. Discharge 40 percent of the run-off from a 1-hour storm with a probable frequency of occurrence of once in 10 years, occurring in any month, when pumping against a river stage with a probable frequency of occurrence of once in 1000 years, for that month.

2. Discharge the seepage through the dike and sanitary sewage from the area (computation indicates that these quantities are very small, and it would be inconsistent with the over-all accuracy of the problem to include them - hence, no further consideration is given to seepage or sanitary sewage flow).

3. Maintain the water-surface elevation in the sewers at the pumping station at or below elevation 10 feet m.s.l., under conditions outlined in Paragraph 1 above.

B. RAINFALL. - Monthly rainfall intensity-frequency curves. Plate No. 6 was drawn for 1-hour storms from the 35 years of record of rainfall at Hartford. These records are complete for all months except the three winter months of December, January, and February. Rainfall intensity-frequency values for these months were taken from the record of 1-hour

storms at Providence, Rhode Island.

<u>Month</u>	<u>1-hour storm</u> <u>10-year frequency</u> <u>inches</u>
January	0.55*
February	0.44*
March	0.43
April	0.53
May	0.63
June	1.20
July	1.50
August	1.45
September	1.10
October	0.76
November	0.52
December	0.52*

* Rainfall intensity from Providence, R. I. records.

C. RUN-OFF COEFFICIENTS. - From a study of the drainage area, the following run-off coefficients were assumed: 0.65 for the months of June, July, August, September, and October; 0.70 for the months of May and November; and 0.80 for the months of December, January, February, March, and April.

D. FREQUENCY OF RIVER STAGES. - From the monthly stage-frequency curves of the Connecticut River at Hartford, Connecticut, shown on Plate 7, the 10-year and 1000-year frequency stages were determined for each month. Plate 10 shows the stage-duration curve for the Connecticut River at Hartford.

E. REQUIRED DISCHARGE CAPACITY. - The amount of seepage through the Connecticut River dike and the amount of sanitary sewage from the area are negligible quantities; therefore, the required discharge capacity is based on surface runoff. The runoff from the area was determined by use of the formula:

$$Q = C I A$$

Q = discharge from the total drainage area, in c.f.s.;

C = the runoff coefficient;

I = intensity of rainfall in inches per hour for the 1-hour storm;

A = total drainage area tributary to the pumping station, in acres.

The following table shows the relationship between the rate of runoff and the corresponding river stage.

Month	1-hr. intensity, inches per hr.	10-yr. Run-off coeff.	Run-off c.f.s.	Connecticut River stage (m s.l.)	40% of 10-yr. run-off c.f.s.
				10-year 1000-year	
January	0.55*	0.80	112	13.9 23.3	45
February	0.44*	0.80	90	15.7 27.8	36
March	0.43	0.80	88	23.2 40.2	35
April	0.53	0.80	113	23.5 28.9	45
May	0.63	0.70	113	18.6 22.2	45
June	1.20	0.65	200	14.1 21.5	80
July	1.50	0.65	250	9.9 21.3	100
August	1.45	0.65	242	8.5 20.3	97
September	1.10	0.65	183	10.2 34.9	73
October	0.76	0.65	126	12.4 33.3	50
November	0.52	0.70	93	14.1 30.8	37
December	0.52*	0.80	106	16.2 25.4	42

* Rainfall intensity from Providence, R.I. records.

The values given in the above table are plotted on Plate 11.

F. REQUIRED PUMP CAPACITY. - The required pump capacity is determined by means of the envelope curve, Plate 11. The required discharge capacity of the pumps, based on the design requirements used, is as follows:

<u>River elevation</u> <u>m.s.l.</u>	<u>Discharge capacity</u> <u>c.f.s.</u>
10	250
22.5	130
30.5	90
38	60

G. INSTALLED PUMP CAPACITY. - The size of pumps to be installed is dependent upon several factors. Naturally, the maximum estimated inflow is the first consideration. However, flexibility of operation, a factor of safety to insure mechanical reliability and available or developed pump sizes also influence the selection. The characteristics of the pumps to be installed for the case at hand are shown on Plate 18.

H. OPERATION. - Normal dry weather flow from the Keeney Lane area will be pumped by the existing Potter Street Pumping Station of the City of Hartford into the Connecticut River Interceptor, through which it will flow to the South Meadows sewage treatment plant.

When the river is low, storm flow from the Keeney Lane area will flow by gravity directly to the Connecticut River either through the present East Side Interceptor or the new outlet through the Keeney Lane Station. When the Connecticut River is high, both sewage and storm water will be pumped to the river by either the existing Potter Street Station or the Keeney Lane Station, or both.

VI. MECHANICAL DESIGN.

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A. GENERAL. - Prior to initiating the actual detail design of the pumping station studies were made to determine the type of equipment to be installed. The studies recognized the fact that the area served is of a semi-industrial and commercial nature and that the sewers have relatively flat grades with the result that material accumulates during low flows and washes out under storm flow. Predicated on these facts, the following type of equipment was selected as being satisfactory and most economical for the purpose.

Gasoline engine driven propeller pumps.

One small motor driven volute pump for dry weather sewage flow.

Hand-operated gate valves on all the pumps.

Swing check valves on all the pumps.

One 20 Kw. gasoline electric generator set.

One 5-ton overhead crane.

Motor operated sluice gates.

Manually cleaned trash racks.

Carbon Dioxide fire extinguisher system.

Two pipe steam heating system.

Necessary switchboard and control equipment.

Upon completion of the studies a conference was held with representatives of the City of Hartford for the purpose of discussing all items of equipment. At that time the city representatives requested that volute pumps be used in lieu of propeller pumps, that the trash racks be mechanically cleaned, that the valves in the pump suction and discharge line be hydraulically operated, and that a Diesel engine be used to drive the sewage pump. This office concurred with the request with the understanding that the

City would reimburse the Government for the additional cost of the equipment that they desired over that which this office proposed to furnish. The equipment requested by the City will, in some respects, facilitate station operations. However, this office is of the opinion that the short period of annual operation does not justify the additional expenditure by the Government.

B. PUMP DRIVE. - Three possible means of driving the pumps were considered; namely, electric motors, Diesel engines and gasoline engines. Electric power is available in the immediate vicinity of the pumping station. However, past experience has shown that in order to be reasonably certain that the pumping station will be able to function under adverse conditions, at least two sources of power with independent transmission lines are necessary. In view of the additional cost of extending a second feeder to the station and the question of reliability of service, the proposal to employ electric power was discarded.

The possible use of Diesel engines was then investigated. The conclusion reached was that the engines would be suitable, but that, except for driving the 16" sewage pump, their high first cost would not be offset by lower operating costs.

Gasoline engines of suitable characteristics can readily be obtained and at reasonable first cost. The failure of an engine, while possible, is unlikely, and the failure of two or more engines simultaneously is very remote. In the event that one engine fails, the danger of flooding while it is being repaired would be alleviated by the excess capacity of the remaining pumps over that which is required. Considering these factors, it was decided to use gasoline engines to drive the 36" pumps.

The gasoline engines will be of the heavy duty industrial type capable of continuously driving the pumps at their rated speed under any head conditions developed. The engines will not use over 85 percent of their developed horsepower at rated speed. They will be mounted on concrete bases and directly connected through disconnecting flexible couplings to the right angle gear units.

The Diesel engine will be a high speed two cycle industrial type capable of continuously driving the pump at its rated speed under any head conditions developed. The engine will not use over 75 percent of its developed horsepower. It will be mounted on a concrete base and directly connected through a disconnecting flexible coupling to the right angle gear unit.

C. PUMPS. - From the maximum required pumping capacity of 250 c.f.s., as determined in Section V, it was determined that provisions should be made to install three pumps. To install a larger number of pumps would materially increase the cost of the station without resulting in any great advantage and a smaller number would seriously limit the operating flexibility and reliability of the station.

No provisions were made in the capacity determined in Section V for possible mechanical failure of equipment. To provide for this contingency, it is considered necessary that any two pumps should be capable of delivering about 85 percent of the 250 c.f.s. A study of pump characteristics indicates that three 36" mixed flow volute pumps would be required; each pump to have a capacity of 106.5 c.f.s., or 48,000 g.p.m., with the river at Elevation 10. In addition, one 16" mixed flow volute pump having a capacity of 6,000 g.p.m. with the river at Elevation 35 will be provided to pump the sanitary sewage at such periods when the river is at flood stage.

D. RIGHT ANGLE GEAR UNITS. - The gear units will be of the self-contained type designed to transmit the power from the horizontal engine shaft through a pair of spiral bevel gears to the vertical pump shaft. The units will be inclosed in a cast iron and structural steel housing and will have a service factor of 1.25 at the maximum power required to drive the pumps under any condition of head.

E. STANDBY GENERATOR UNIT. - A gasoline engine-driven generator will be provided to furnish electric power at 230 volt, 3 phase and 115 volt, single phase in the event of failure of commercial power. The unit will have a normal full-load capacity of 25.0 Kva. which will be sufficient to maintain in operation the electrical auxiliaries and the station lighting system.

F. CRANE. - A 5-ton overhead crane will be installed in the engine room to facilitate the repairing and installation of any items of equipment. The crane will be of standard construction, hand-operated throughout. An electrical operated one-half ton hoist will be attached to the crane to lift cans of screenings from the rack room to the engine room.

G. SLUICE GATES. - Two motor operated sluice gates will be located at the entrance to the pump suction chamber. These gates will normally be kept closed to prevent water from collecting in the suction chamber. They will be opened only at such periods as is necessary to operate the pumps. A third motor operated sluice gate will be located in the gravity discharge conduit to prevent backflow during periods when pumping is necessary. This gate will be normally kept open to permit water to flow by gravity to the river.

H. WATER SYSTEM. - The city water supply will be connected to the pumping station and will be used for cooling the gasoline engines and operating the hydraulic gate valves on the 36" pumps.

I. FUEL SYSTEMS. - Gasoline will be stored in a 3000 gallon tank, and Diesel oil will be stored in a 1000 gallon tank. Both tanks will be buried in the ground adjacent to the building. Each engine will be supplied through an individual line running directly to its respective fuel tank. Drip pans will be provided on each gasoline engine carburetor and connected to a common header returning to the gasoline tank. All interior piping will be 3/4 inch inside diameter, copper tubing with flared joint fittings, exterior piping will be wrought iron. At points where the fuel lines are embedded in concrete or pass through beams or walls, they will be protected by wrought pipe sleeves.

J. SUMP PUMPS. - Two sump pumps will be provided, one in each end of the pump room. One pump will have a capacity of 30 g.p.m. and will be used only to keep the pump room dry. The other pump will have a capacity of 100 g.p.m. This pump will be used to keep the pump room dry and will also be used to unwater the suction chamber.

K. VALVES. - Gate valves on the 16" sewage pump will be hand-operated. On the 36" pumps, the gate valves will be hydraulically operated, using City water pressure. A small pump connected to a storage tank will be installed for emergency use. Swing check valves will be provided to prevent reverse rotation of the gear units and gasoline engines in the event that an engine stalls. In addition, their use facilitates the starting of the units.

L. TRASH RACKS. - Two six-foot wide, mechanically cleaned, trash racks will be installed directly behind the sluice gates at the entrance to the suction chamber.

M. FIRE EXTINGUISHER SYSTEM. - A carbon dioxide fire extinguishing system will be installed and so arranged that any gasoline engine can be

blanketed with gas by tripping a valve just inside the main entrance to the building. Portable extinguishers will be provided to care for any other emergencies.

N. HEATING SYSTEM. - The heating system will be of the two pipe gravity type consisting of an oil fired boiler supplying steam to unit heaters in the engine room. The oil burner will be of the automatic pressure atomizing type with constant electric ignition. The unit heaters will be of ample capacity to heat the engine room under the coldest weather conditions.

O. POWER SOURCE. - Power requirements for the station will be approximately 20 Kw. Power will be delivered to the station at 115/230 volts, three phase, 60 cycles over a four-wire grounded system, through a bank of "T" connected transformers. From the transformers, power will be taken to the station through an underground feeder.

P. SWITCHBOARD AND CONTROL EQUIPMENT. - The switchboard will be of the dead front, steel enclosed, low-voltage type with all controls and meters flush-mounted on the front. All air circuit breakers will be manually operated. Circuit breakers for the incoming feeder and standby generator feeder will be rated 600 volts, 60 cycles A. C. provided with instantaneous and time-delay magnetic overcurrent trips and interlocked so that only one breaker can be in the closed position at any one time. All breakers operating three phase circuits will be rated 600 volts, 60 cycles A. C. of suitable ampere rating.

A distribution panelboard will be installed in the station to distribute power to the various light, receptacle, fan and heater circuits.

VII. STRUCTURAL DESIGN.

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A. SPECIFICATIONS FOR STRUCTURAL DESIGN. -

1. General. - The structural design of the Keeney Lane Pumping Station has been executed in general in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5	pounds	per	cubic	foot
Dry earth	100	"	"	"	"
Saturated earth	125	"	"	"	"
Concrete	150	"	"	"	"
Brick	120	"	"	"	"

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the standard specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house structure and conduits is based on a comprehensive strength of 3,000 pounds per square inch in 28 days.

<u>b. Flexure (f_c). -</u>	<u>Lbs. per sq. in.</u>
Extreme fibre stress in compression	800
Extreme fibre stress in compression	
adjacent to supports of continuous or fixed beams or rigid frames ...	900
<u>c. Shear (v). -</u>	
Beams with no web reinforcement and without	
special anchorage	60
Beams with no web reinforcement but with	
special anchorage of longitudinal steel	90
Beams with properly designed web reinforcement	
but without special anchorage of longitudinal steel	180
Beams with properly designed web reinforcement	
and with special anchorage of longitudinal steel	270
Footings where longitudinal bars have no	
special anchorage	60
Footings where longitudinal bars have	
special anchorage	90
<u>d. Bond (u). -</u>	
In beams, slabs, and one way footings	100
Where special anchorage is provided	200
The above stresses are for deformed bars.	
<u>e. Bearing (f_c). -</u>	
Where a concrete member has an area at least	
twice the area in bearing	500
<u>f. Axial compression (f_c). -</u>	
Columns with lateral ties	675

g. Steel stresses. -

Tension	20,000
Web reinforcement	16,000

h. Protective concrete covering. -

<u>Type of members</u>	<u>Minimum cover in inches</u>
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature of spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams together with the columns to which they are connected, form portal frames which take up wind load and crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. - a. Structural steel columns in the side walls and end walls of the superstructure take up the direct roof loads as well as all wind loads on the sides of the superstructure. In addition, the

columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column design, a pin-ended condition at the base being assumed.

b. Wall columns in the ends of the building were designed for full dead load and live load from roof, plus wind load on the building.

c. Allowable stress in columns were figured from $f = 17000 - 0.485 \left(\frac{l}{r} \right)^2$ formula with a maximum allowable stress of 15,000# per square inch for dead load plus live load, and a maximum allowable stress of 20,000# per square inch for combined dead load, live load, and wind load: l/r limited not to exceed 120.

4. Engine room floor. - The engine room floor is designed to carry all engines, motors, etc., actually to be placed on the floor, as well as a uniform load.

The following assumptions were made for design purposes.

a. For the floor slab and removable steel floor plates above the pump room, the design loads are the estimated dead load plus a uniform live load of 300# per square foot.

b. For the floor slab and removable steel floor plates above the trash rack chamber and the boiler room, the design loads are the estimated dead loads plus a uniform live load of 400# per square foot.

c. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline and Diesel engines, and a uniform live load on the unoccupied portion of the floor slabs which contribute loads to the beams under

consideration. The uniform live load for beams over the pump room is 250 $\frac{#}{sq. ft.}$ per sq. ft. and for the beams over the trash rack room and boiler room 300 $\frac{#}{sq. ft.}$ per sq. ft. For the machinery loads, an impact factor of 100 percent has been added.

5. Trash rack room and boiler room floors. - The following load assumptions were made for design purposes in designing the trash rack room and boiler room floors.

a. For the trash rack chamber, the design loads for the floor slab and removable steel cover plates are the estimated dead loads plus a uniform live load of 400 $\frac{#}{sq. ft.}$ per sq. ft.; for the room south of the trash rack chamber a uniform live load of 200 $\frac{#}{sq. ft.}$ per sq. ft. was assumed.

b. For the boiler room, the design loads for the floor slab are the estimated dead loads, a uniform live load of 200 $\frac{#}{sq. ft.}$ per sq. ft. and for the horizontal thrust from the north wall.

c. For the trash rack room floor beams, the design loads are the estimated dead loads and a uniform live load of 200 $\frac{#}{sq. ft.}$ per sq. ft.

6. Substructure. - a. The substructure is to be of reinforced concrete. The temporary end wall and trash rack chamber of the existing Keeney Lane Pumping Station is to be removed and the substructure of the new station joined to the old so that it becomes an integral part of it. The asphalt coating on the reinforcing bars extending from the old substructure is to be thoroughly cleaned off and the bars straightened out so that they will bond into the new substructure.

b. Membrane waterproofing is called for to be placed over the outer surface of the substructure walls. Waterproofing may be omitted for the suction chamber and discharge conduit as well as on the west wall below the level of the trash rack chamber and boiler room floors where

such waterproofing would be of no value.

c. For the length of the pump room the side walls, suction chamber and discharge conduit were designed as one monolithic continuous structure with the walls assumed hinged at the top. The portion of the north wall beyond the pump room was designed as a continuous structure hinged at the top and fixed at a beam in the floor slab at the end of the trash rack dividing wall. The portion of the west wall and pump room dividing wall parallel and opposite to the trash rack dividing wall was designed as a continuous structure hinged at the top, supported at the trash rack chamber floor and fixed at the base slab of the pump room. The remaining sections at each end of the west wall were designed as hinged at the top, supported at the intermediate floor level and continuous with the base. The south wall was designed as a continuous section hinged at the top, supported at the intermediate floor level, and fixed at a beam in the base slab directly under the wall with the gate openings. The interior walls were designed to take gate loads and horizontal and vertical reactions from adjoining walls and slabs. The base slab of the intake conduit extending approximately 2-1/2 feet beyond the station was designed as a cantilever extending from the station. The walls and roof of this section were designed as a continuous bent with both legs fixed at the base slab. The intake conduit connecting the diversion chamber to the station was designed as a continuous frame.

d. The loading consisted of the vertical loads due to the weight of the structure; the vertical live and impact loads from the engine room floor; the roof live load and the thrusts against the walls from earth and water pressure. The discharge conduit is also subjected to a bursting pressure reaching a maximum when the river reaches elevation 44.4 ft.

Finished ground elevation will be at +23.5 while the bottom of the pump room floor slab will be at elevation -5.8. Ground water was assumed as reaching elevation +12.0. The station was found to load the soil to a pressure of 2750 $\frac{1}{2}$ per sq. ft. maximum.

7. Stairways and ladders. - Concrete stairways provide access to the boiler room and trash rack chamber. An open grating stairway leads from the boiler room to the pump room.. Steel ladders are provided in each gate wall. Cast iron ladder rungs are provided for access to the back side of each trash rack.

8. Trash racks. - The trash racks are mechanically operated. Recesses were provided in the walls and base slab for the racks to be slid into place and grouted in.

9. Steady beams. - Steady beams are required to support the shafts from the right angle gear units to the pumps. Each beam is made of two 10 inch steel channels connected with batten plates and lattice bars to form a stiff horizontal girder. The component parts of the steady beam are bolted together throughout.

C. ARCHITECTURE.

1. Pumping Station. - The pumping station will be a building of modern design, in keeping with the architectural treatment used on similar projects elsewhere on the Connecticut River.

The existing 30'-6" wide by 30'-9" long substructure together with the existing floor slab and concrete curb will be reused in the construction of the new pumping station. The existing concrete curb will be built up to meet the new height required for architectural design.

The pumping station will be a flat roofed, brick and glass block structure with cast stone trim, 30'-6" x 75'-0" outside dimensions

with an all addition 9'-0" x 26'-0" on the west end of the south wall.

The 13 inch thick brick walls are capped with a cast stone coping and extend above the roof slab to form a parapet wall around the entire building. A flat type roof was chosen as being economical and in keeping with the architectural design, as well as serving as a location for the engine exhaust mufflers. The roof system consists of steel beams encased in concrete and supported by steel columns. The roof slab will be 5-1/2 inches thick, covered with a cinder concrete fill, over which a 4-ply asphalt and gravel roofing will be placed. The roof is sloped to drain toward the north side of the building and roof drainage is ~~emptied~~ into the suction chamber by means of downspouts. There are no outside pilasters except the two 8-inch pilasters at the main entrance and a portion of the south wall which projects 4 inches, to obtain architectural treatment. Inside the building there are pilasters at the chimney and at each structural steel column, the pilasters forming fireproof column encasements. The engine room floor will be an 8-inch structural concrete floor slab. A hand-operated traveling crane of 5 tons lifting capacity will operate for the full length of the building and will be used for installing and moving pumps and machinery. Access for the crane hoist to the pump room will be through two 7' x 10' openings in the engine room floor, these openings being normally covered with removable checkered floor plates.

There are no window sash in the building. Light will be admitted through glass block panels. The well-diffused and uniform light which they provide and their appearance is also in keeping with the spirit of the architectural design. To provide ventilation for the engine room, adjustable louvers have been placed low in the exterior brick walls. The pump room and the trash rack chamber are ventilated by

electric motor operated blowers, exhausted through fixed louvers, set low in the exterior brick walls. The boiler room is vented by a gravity duct which exhausts through a grille in one of the main entrance pilasters.

Two doors give access into the building.

The main entrance door, 7'-6" wide by 10'-0" high consists of two leafs, flush, hollow metal construction and gives entrance directly to the engine room floor. It is large enough to provide adequate clearance for any replacement of mechanical equipment which may be required in the future. The 3'-0" wide by 7'-0" high hollow metal door on the east side of the building provides a service entrance into the station. Access to the roof is obtained by means of a steel ladder in the face of the east wall and is close by the service door.

VIII. CONSTRUCTION PROCEDURE.

VIII. CONSTRUCTION PROCEDURE.

A. SEQUENCE OF OPERATIONS. - The schedule of work will require the contractor to remove the existing temporary pumping station superstructure and construct the new pumping station utilizing the existing substructure and complete all work in 250 calendar days after receipt by the contractor of notice to proceed.

B. CONCRETE CONSTRUCTION.

1. Composition of concrete. - The concrete will be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture. All concrete will be Class A except the base slab which will be Class B. Class A concrete will have an average compressive stress of not less than 3400 lbs. per square inch in accordance with a standard 28-day test. The average compressive stress for Class B concrete will be 3000 lbs. per square inch in accordance with a standard 28-day test. Concrete will be tested by the Central Concrete Laboratory, Mount Vernon, N. Y.

a. Cement. - Cement will be tested by the Central Concrete Laboratory and results of these tests shall be known before the cement is used. Portland cement of a well-known and acceptable brand will be used throughout.

b. Fine aggregate. - Natural sand will be used as a fine aggregate. The aggregate will be subject to thorough analysis, including magnesium sulphate soundness tests, and tests made on mortar specimens for compressive strength.

c. Coarse aggregate. - Washed gravel or crushed stone of required sizes will be used as coarse aggregate. It will consist of hard,

tough and durable particles free from adherent coating and will be free from vegetable matter. Only a small amount of soft, friable, thin or elongated particles will be allowed. The aggregate will be subject to accelerated freezing and thawing tests and to thorough analysis, including magnesium sulphate tests for soundness.

d. Water. - The amount of water used per bag of cement for each batch of concrete will be predetermined; in general, it will be the minimum amount necessary to produce a plastic mixture of the strength specified. Slump tests will be required in accordance with the specifications.

2. Field control.

a. Storage. - The concrete components will be stored in a thoroughly dry, weather-tight and properly ventilated building. The fine and coarse aggregates will be stored in such a manner that inclusion of foreign material will be avoided.

b. Mixing. - The exact proportions of all materials in the concrete will be predetermined. The mixing will be done in approved mechanical mixers of a rotating type, and there will be adequate facilities for accurate measurement and control of each of the materials used in the concrete. Mixing will be done in batches of sizes as directed and samples will be taken for slump tests and for compressive strength tests. Inspectors will at all times supervise and inspect the mixing procedure.

c. Placing. - Concrete will be placed before the initial set has occurred. Forms will be clean, oiled, rigidly braced and of ample strength. Concrete poured directly against the ground will be placed on clean damp surfaces. Mechanical vibrators will be used and forking or hand-spading will be applied adjacent to forms on exposed surfaces to insure

smooth even surfaces. The location of vertical and horizontal construction joints as well as contraction and expansion joints, and the location of water stops are indicated on the drawings. The locations of construction joints are tentative and may be changed to suit conditions in the field. Before placing concrete, all reinforcing steel will be inspected and pouring of the concrete will be supervised and directed by Government inspectors. Adequate precautions will be taken if concrete is to be placed in cold or hot weather.

3. Joining the new substructure to existing substructure.

a. Removal of existing structures. - The temporary end wall of the substructure of the existing station, the trash rack chamber, the two transition sections and the connecting concrete pipe of the existing intake conduit will be removed. The concrete plug in the discharge conduit will be drilled out to permit removal and the faces dressed smooth to the dimensions of the present conduit.

b. Cleaning. - The surfaces of the existing pump room walls and conduits to which the new substructure is to be joined will be thoroughly cleaned of all mastic and deleterious material. The copper water stops will be cleaned of all old concrete and mastic and straightened out to permit bonding into the new concrete. Reinforcing bars will be cleaned of all mastic or asphaltic paint, and straightened out to bond into the new substructure.

c. STRUCTURAL STEEL CONSTRUCTION. - Structural steel consists of the frame work for the superstructure, a stairway and the miscellaneous frames, angles, checkered plates, crane rails, railings and ladders.

1. Superstructure framework. - The superstructure framework consists of beams and columns which will form a skeleton frame for the exterior walls and roof, and will provide a runway for the hand-operated crane. The columns will be securely anchored to the concrete walls and will be connected

to the roof beams with web connection angles and wind bracing connections. The crane rails will be fastened to the crane runway beams with bent hook bolts. Crane stops at each end of the runway will prevent the traveling crane from running into the end walls.

2. Stairway. - The stairway treads in the pump room will be supported on structural steel channels. Pipe railings are to be fastened to the top flanges of the stairway channels.

3. Removable floor plates. - Access for the crane to the pump room will be obtained by removing checkered floor plates. The removable covers consist of checkered plates welded to angles. Each opening in the floor is covered. Lifting handles are provided in the plates for easy removal.

4. Miscellaneous angles and frames. - Miscellaneous structural steel such as door frames, angles, grilles, etc., will be erected and placed as indicated on the drawings and at such time as required.

D. CONSTRUCTION PERIOD. - A study of hydrographs of the Connecticut River plotted from data recorded by the United States Weather Bureau from 1917 to 1938, a total of 22 consecutive years, shows that the majority of the floods at Hartford occur in the spring months of March, April, and May. The site of the pumping station is at approximately elevation 22.0 m.s.l. With the exception of 1930, it will be noted that floods have reached elevation 18.0 m.s.l. or more, every spring. However, between May 15 and December 1 only twice has the peak of any flood reached elevation 20.0 m.s.l. as follows:

<u>Date</u>	<u>Elevation of High Water</u>
November 8, 1927	29.2
September 23, 1938	35.4

Consideration of this matter including a study of the above table leads to the conclusion that protection to elevation 26.0 m.s.l. will probably be sufficient. The contractor will be responsible for all damage by floods to elevation 26.0 while the Government will be responsible for damage by floods which may exceed elevation 26.0; the contractor being required to repair all such damage at contract unit prices. It is proposed to have the work carried out approximately in accordance with the following construction schedule:

Designation	: Quantity:	: Time Limits:	: No. of	: Daily Rate of:	
	: Cu.Yds.:	: of	: Working:	: Construction:	: Re-
	: Cu.Yds.:	: Operations:	: Days:	: Cu.Yds.:	: marks
Common Excavation	: 4250	: No date	: 12	: 350	:
Rock Excavation	: None	: No date	: -	: -	:
Concrete in substructure, etc.	: 635	: No date	: 16	: 40	:
Backfill	: 2100	: No date	: 5	: 420	:
Structural steel con- struction	:	: No date	: 10	:	:
Removal of wooden super- structure and masonry substructure	:	: No date	: 150	:	:
Installation of equipment	:	: No date	: 50	:	:
Job completed	:	: No date	: 250	:	:

E. INSTALLATION OF EQUIPMENT. - The installation of the electrical and mechanical equipment will be completed within the 250 days allowed for the construction of the station.

F. INSPECTION AND TESTS. - Field inspection of all portions of the construction work will be made. Progress reports during construction will include a log of the work accomplished and the number of workers on the job.

Field and laboratory tests of concrete and other materials will control the quality of the work.

IX. SUMMARY OF COST.

IX. SUMMARY OF COST.

The total construction cost of the Keenoy Lane Pumping Station including the conduit connection and mechanical equipment, has been estimated to be \$123,900, including 15 percent for engineering and 10 percent for contingencies. This amount has been distributed as follows:

(1) Pumping Station:

<u>a.</u>	Concrete features	\$23,400
<u>b.</u>	Superstructure	23,100
<u>c.</u>	Miscellaneous	<u>16,600</u>
		\$63,100

(2)	Mechanical Equipment	<u>60,800</u>
	TOTAL	\$123,900

(1) a. - The "concrete features" consist of intake structures, foundation of pumping station and outlet connection to existing conduit.

(1) b. - "Superstructure" consists of the complete brick and steel building above the operating floor.

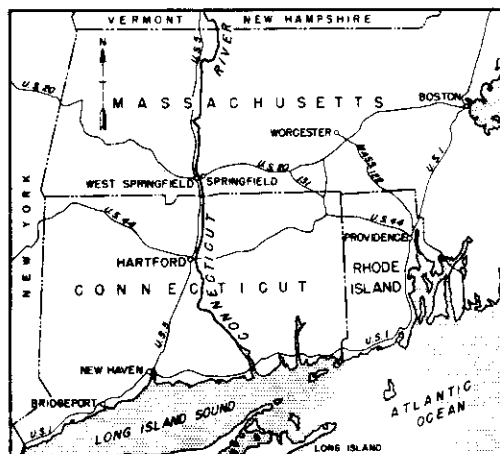
(1) c. - "Miscellaneous" items are common excavation and backfill, removal of existing superstructure, miscellaneous iron and steel, trash racks and other items not included in (1) a above.

(2) - "Mechanical equipment" consists of three pumps, gas engines, gear units, valves and piping and miscellaneous items.

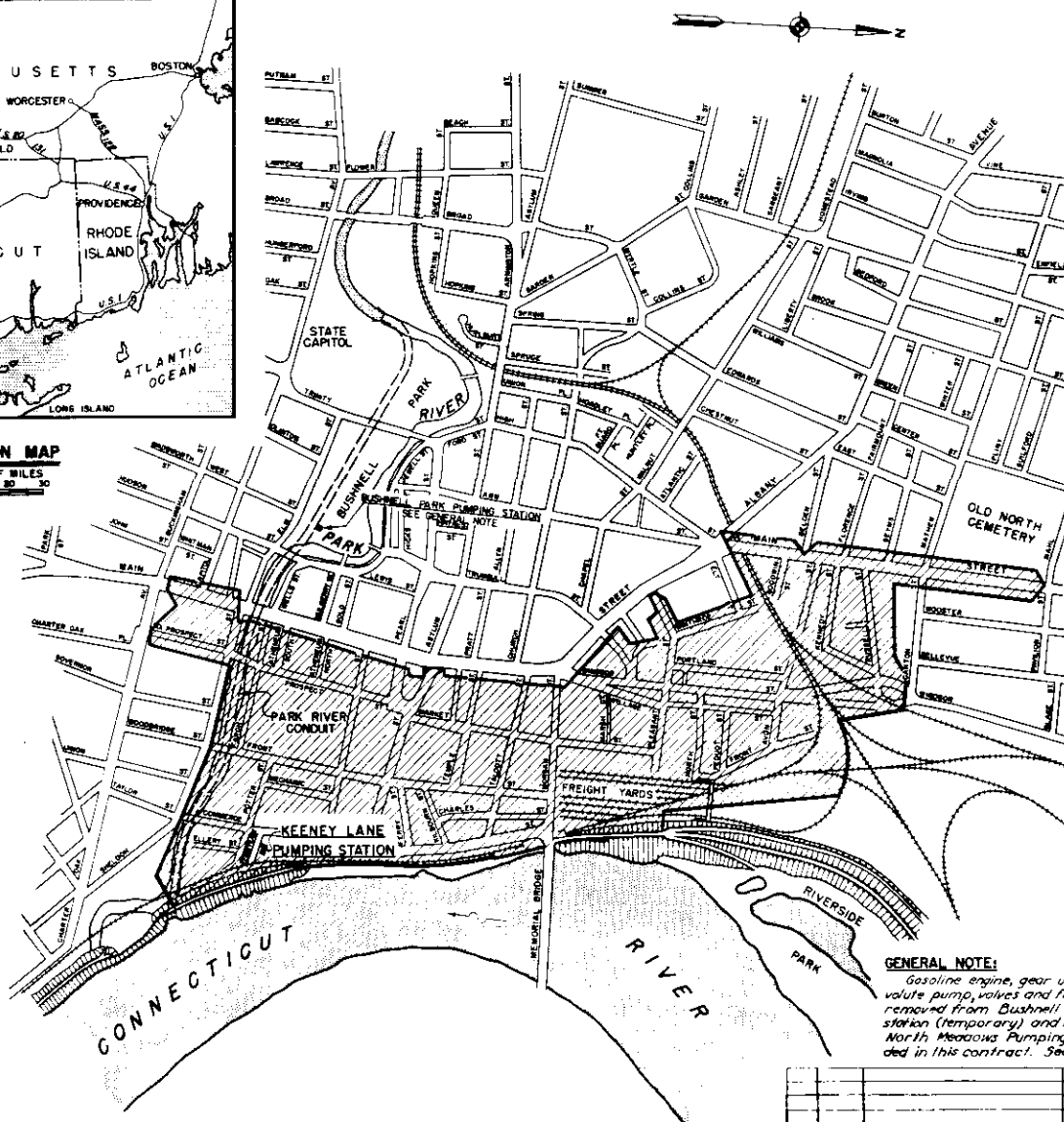
INDEX OF PLATES.

ANALYSIS OF DESIGN
KEENEY LANE PUMPING STATION
INDEX OF PLATES

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1	Project, Location & Drainage Areas
2	General Plan
3	Sewer Interceptors Plan
4	Geologic and Soil Section
5	Providence District Soils Classification
6	Rainfall Intensity Frequency Curve
7	Stage Frequency Curves
8	Hydrograph No. 1
9	Hydrograph No. 2
10	Stage Duration Curve
11	Required Pump Capacity Curve
12	Operating Floor Plan (Architectural)
13	Pumping Station Elevation (Architectural)
14	General Arrangement of Equipment No. 1
15	General Arrangement of Equipment No. 2
16	General Arrangement of Equipment No. 3
17	General Arrangement of Equipment No. 4
18	Proposed Pump Capacity
19	Organization Chart



LOCATION MAP
SCALE OF MILES
0 10 20 30

**GENERAL NOTE:**

Gasoline engine, gear unit, silencer, 1-30" valve pump, valves and fittings to be removed from Bushnell Park Pumping Station (temporary) and reinstalled in North Meadows Pumping Station, included in this contract. See specifications.

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3	HYDROGRAPH NO. 2	CT-4-3229
4	SUBSURFACE EXPLORATIONS	CT-4-3230
5	PLAT PLAN	CT-4-3231
6	INTAKE PUMP ROOM AND OUTLET PLAN	CT-4-3232
7	INTAKE STRUCTURE - PROFILE AND SECTIONS	CT-4-3233
8	ENGINE ROOM FLOOR PLAN - ARCHITECTURAL	CT-4-3234
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LEGEND

Limits of Drainage Area for Keeney Lane Pumping Station.

CONNECTICUT RIVER FLOOD CONTROL
KEENEY LANE PUMPING STATION
HARTFORD, CONN.

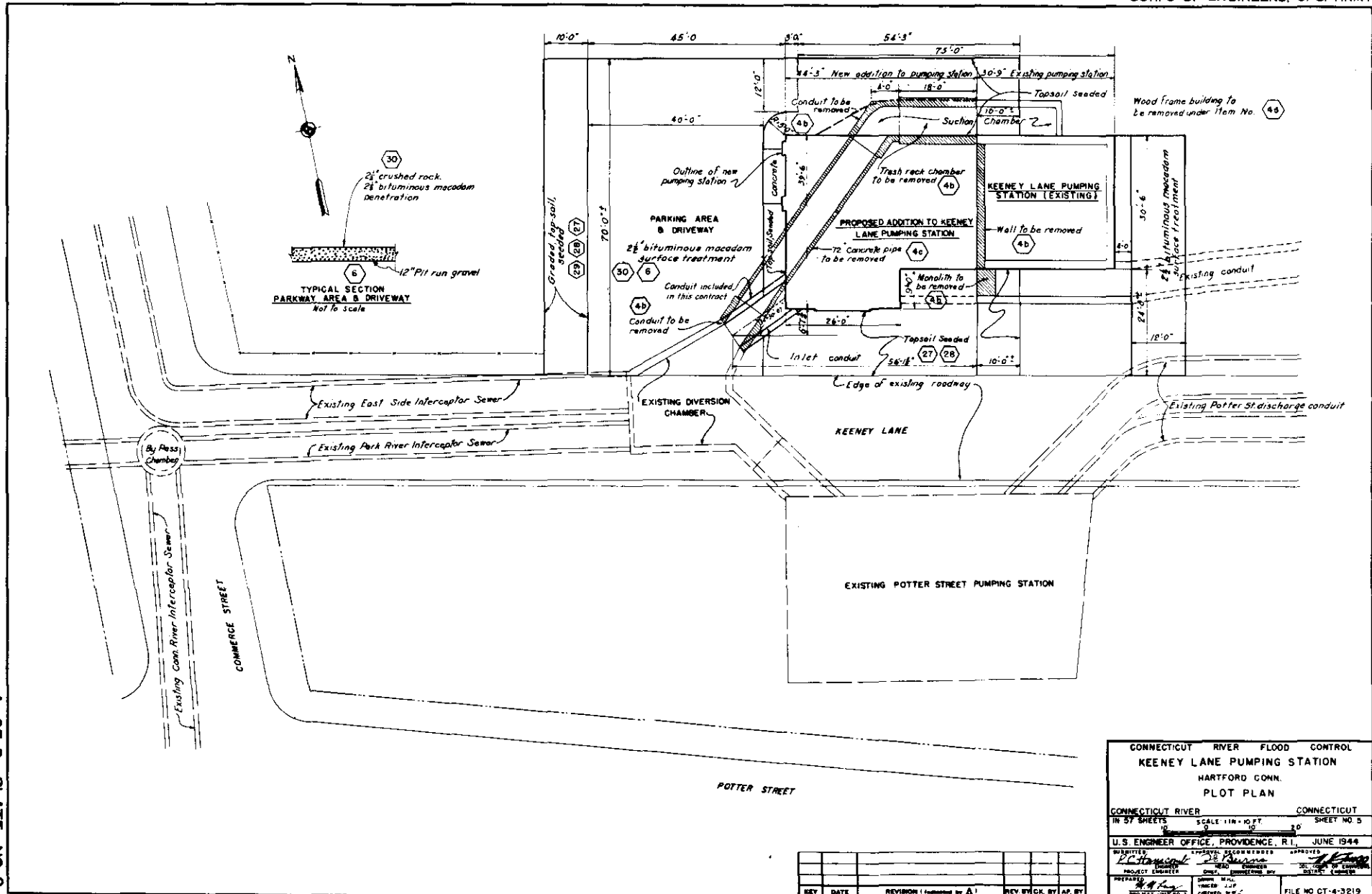
PROJECT LOCATION AND INDEX

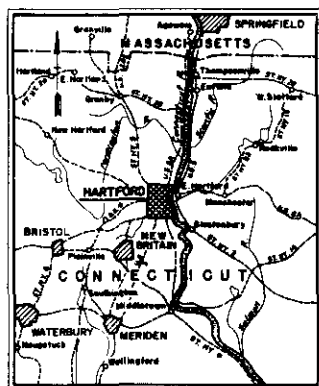
CONNECTICUT RIVER CONNECTICUT
IN 57 SHEETS SCALE 1" = 500 FT. SHEET NO. 1

U S ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944

APPROVED: PROJECT ENGINEER
CHECKED: PROJECT ENGINEER
FILE NO. CT-4-3218

A OF D PLATE NO. 2





LOCATION MAP

SCALE 1 IN. = 5 MILES

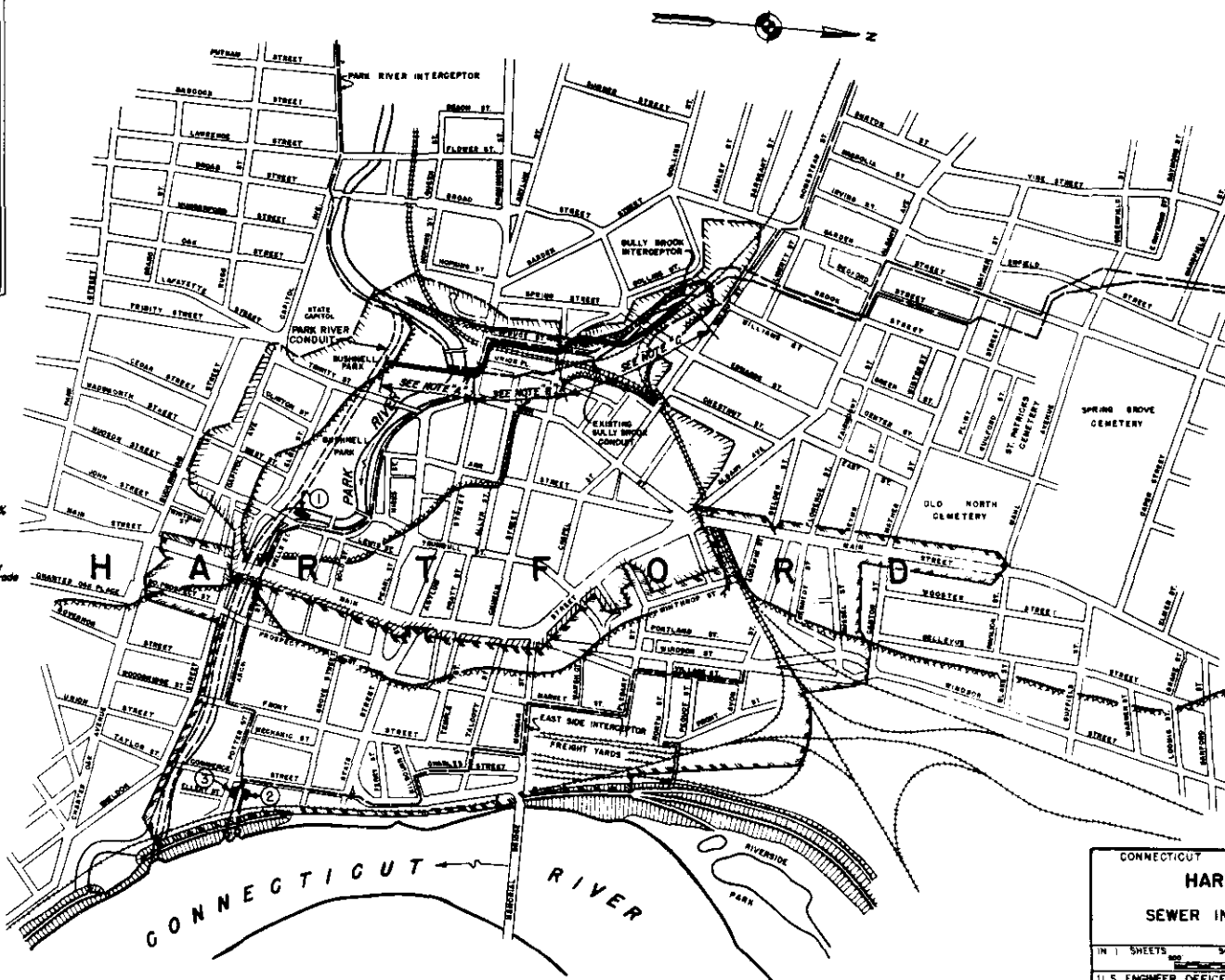
NOTE

- A- 845 feet of twin conduit, 94.7' @ 0.15% grade, built by City of Hartford
 B & C Gully Brook as proposed by the City of Hartford:
 B- 504 feet of 11.25" conduit @ 0.64% grade
 C- 1370 feet of 11" x 9.5" conduit @ 0.38% grade

LEGEND

- Area subject to flooding
 Limits of area served by Bushnell Park Pumping Station
 Limits of area served by Keeney Lane Pumping Station

- ① Proposed Bushnell Park Pumping Station
 ② Proposed Keeney Lane Pumping Station
 ③ Existing Potter Street Pumping Station



CONNECTICUT RIVER FLOOD CONTROL

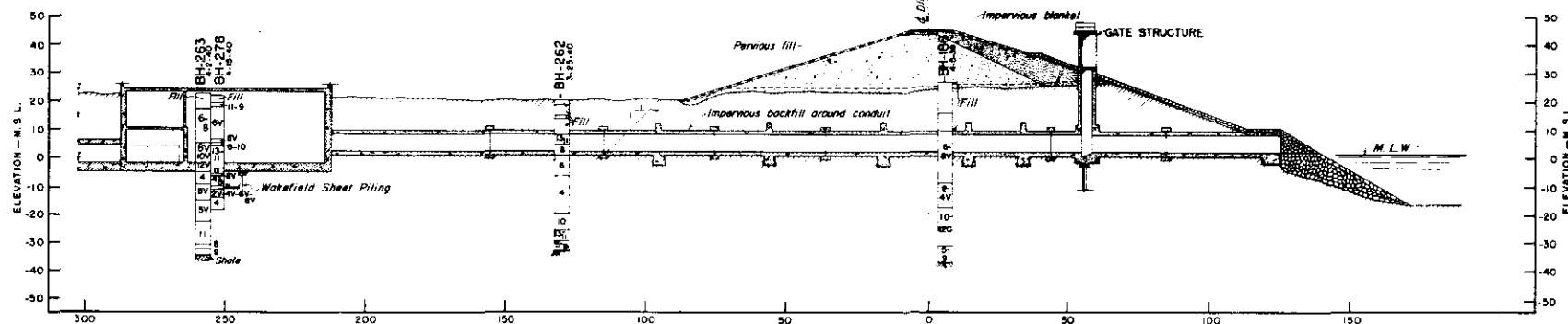
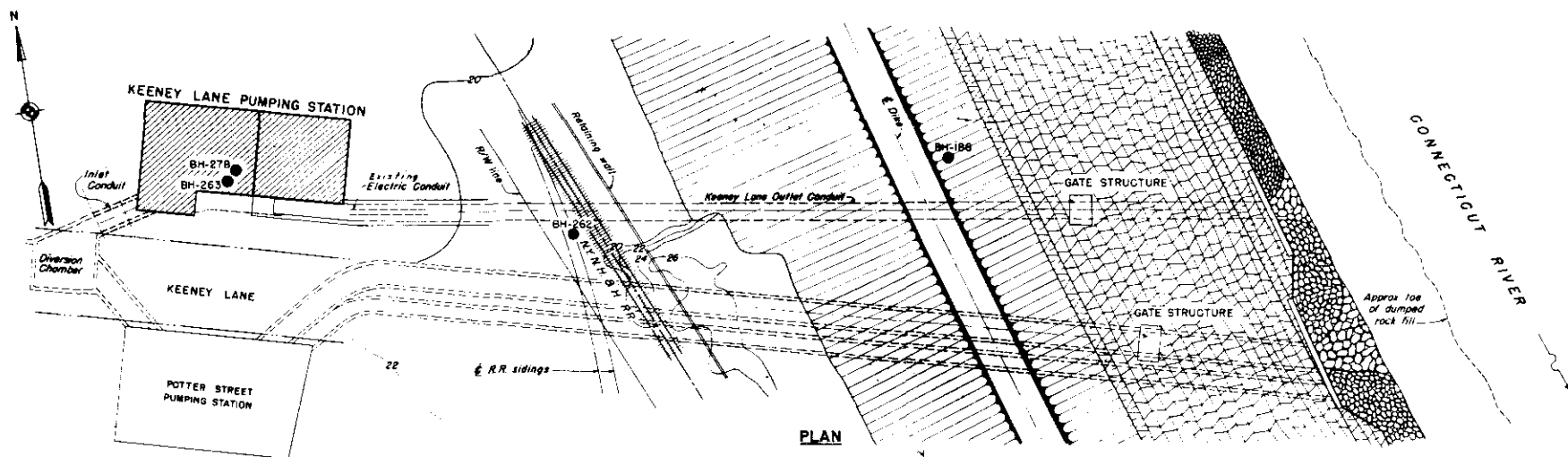
HARTFORD, CONN.

SEWER INTERCEPTOR PLAN

IN 1 SHEETS SCALE 1 IN. = 500 FT. SHEET NO. 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. JUNE, 1941

DESIGNED BY: [Signature] APPROVED BY: [Signature]
 CHECKED BY: [Signature] TRACED BY: [Signature]
 L. E. LADD, CHIEF ENGINEER



DESCRIPTION OF SOIL CLASSES

- | | |
|--|--|
| 1. Graded from Gravel to Coarse Sand - Contains little medium sand. | 9. Graded from Gravel to Medium Silt - Contains little fine silt. |
| 2. Coarse to Medium Sand - Contains little gravel and fine sand. | 10. Medium to Fine Silt - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt. |
| 3. Graded from Gravel to Medium Sand - Contains little fine sand. | 10C. Medium Silt to Coarse Clay - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay. |
| 4. Medium to Fine Sand - Contains little coarse sand and coarse silt. | 11. Graded from Gravel or Coarse Sand to Fine Silt - Contains little coarse clay. |
| 5. Graded from Gravel to Fine Sand - Contains little coarse silt. | 12. Fine Silt to Clay - Contains little medium silt and fine clay (colloid). Possesses behavior characteristics of silt. |
| 6. Fine Sand to Coarse Silt - Contains little medium sand and medium silt. | 12C. Clay - Contains little silt. Possesses behavior characteristics of clay. |
| 7. Graded from Gravel to Coarse Silt - Contains little medium silt. | 13. Graded from Coarse Sand to Clay - Contains little fine clay (colloid). Possesses behavior characteristics of silt. |
| 8. Coarse to Medium Silt - Contains little fine sand and fine silt. | 13C. Clay - Graded from sand to fine clay (colloid). Possesses behavior characteristics of clay. |

PROFILE ALONG KEENEY LANE CONDUIT

NOTES

Samples, logs, and test results may be inspected at U. S. Engineer Office, Providence, R. I.
Soils having classifications of two soil classes (i.e. 4-2) have coarser portion of soil in initial class (4), and finer portion in final class (2).
Contours shown are those taken at time of exploration and before construction operations.

LEGEND

av - Numerical class (Providence District Soil Classification).
Letter "V" indicates visual classification.
BH - Bore Hole.

KEY	DATE	REVISION	BY	CHKD BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
KEENEY LANE PUMPING STATION
HARTFORD, CONN.
SUBSURFACE EXPLORATIONS

CONNECTICUT RIVER		CONNECTICUT	
IN 57 SHEETS		SHEET NO. 4	
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., JUNE 1944			
DESIGNED BY H. J. Kane	CHECKED BY T. S. Thomas	APPROVED BY H. J. Kane	
HEAD, SOILS LABORATORY	CHIEF, FIELD ENGINEERING	DEPUTY CHIEF, FIELD ENGINEERING	
PREPARED BY H. J. Kane	DRAWN BY H. J. Kane	FILE NO. CT-R-1590	

PROVIDENCE DISTRICT SOIL CLASSIFICATION

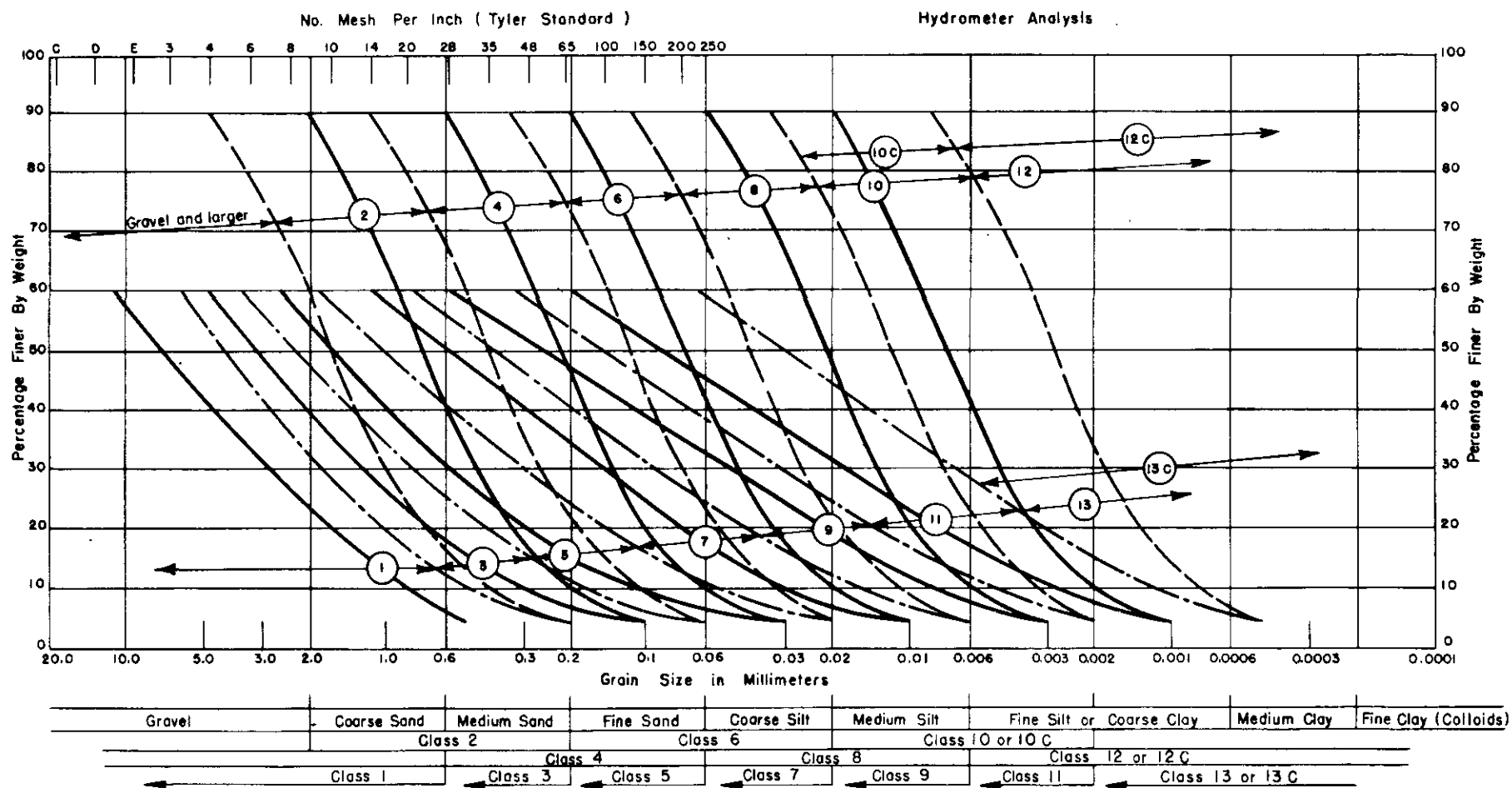
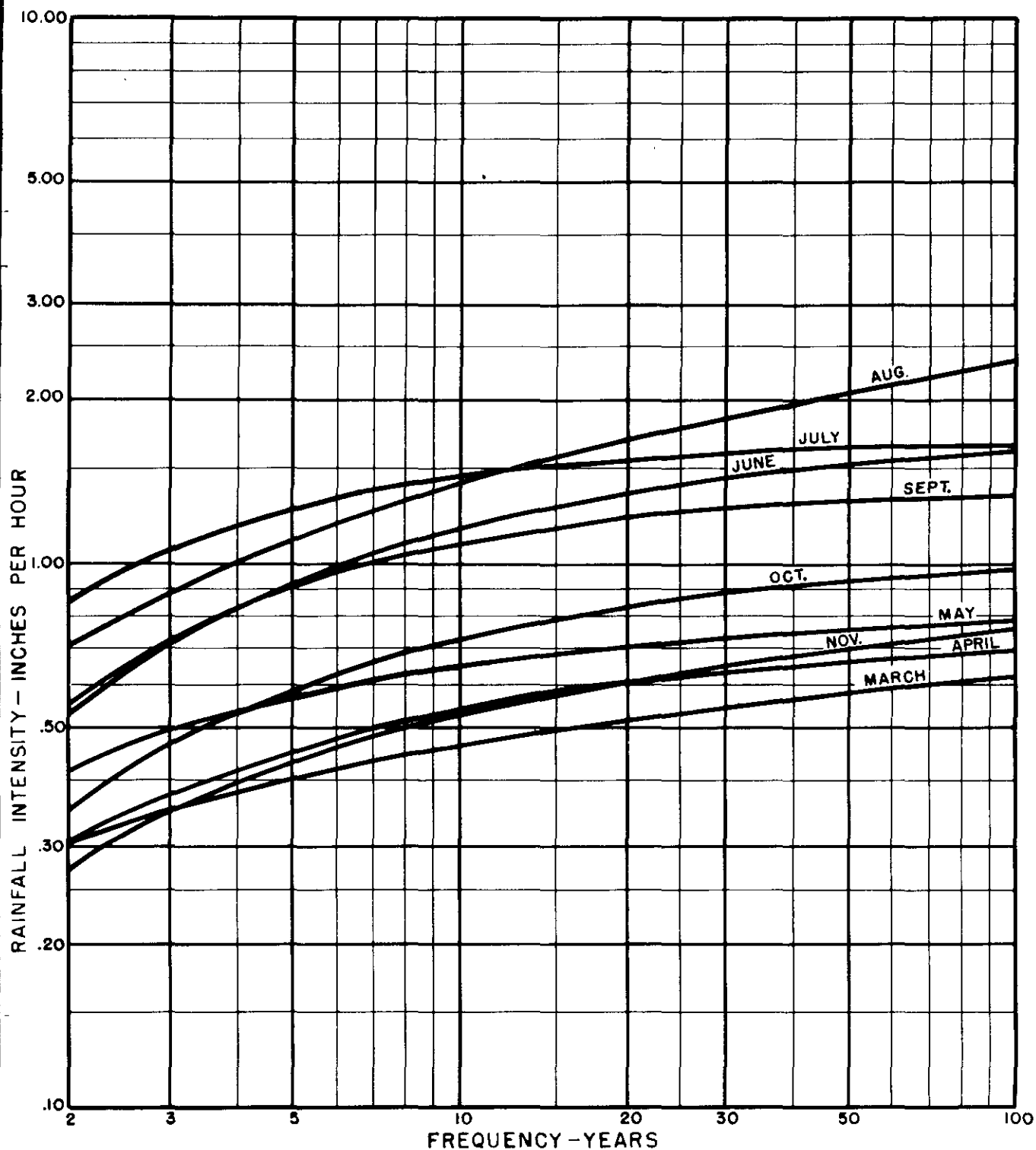
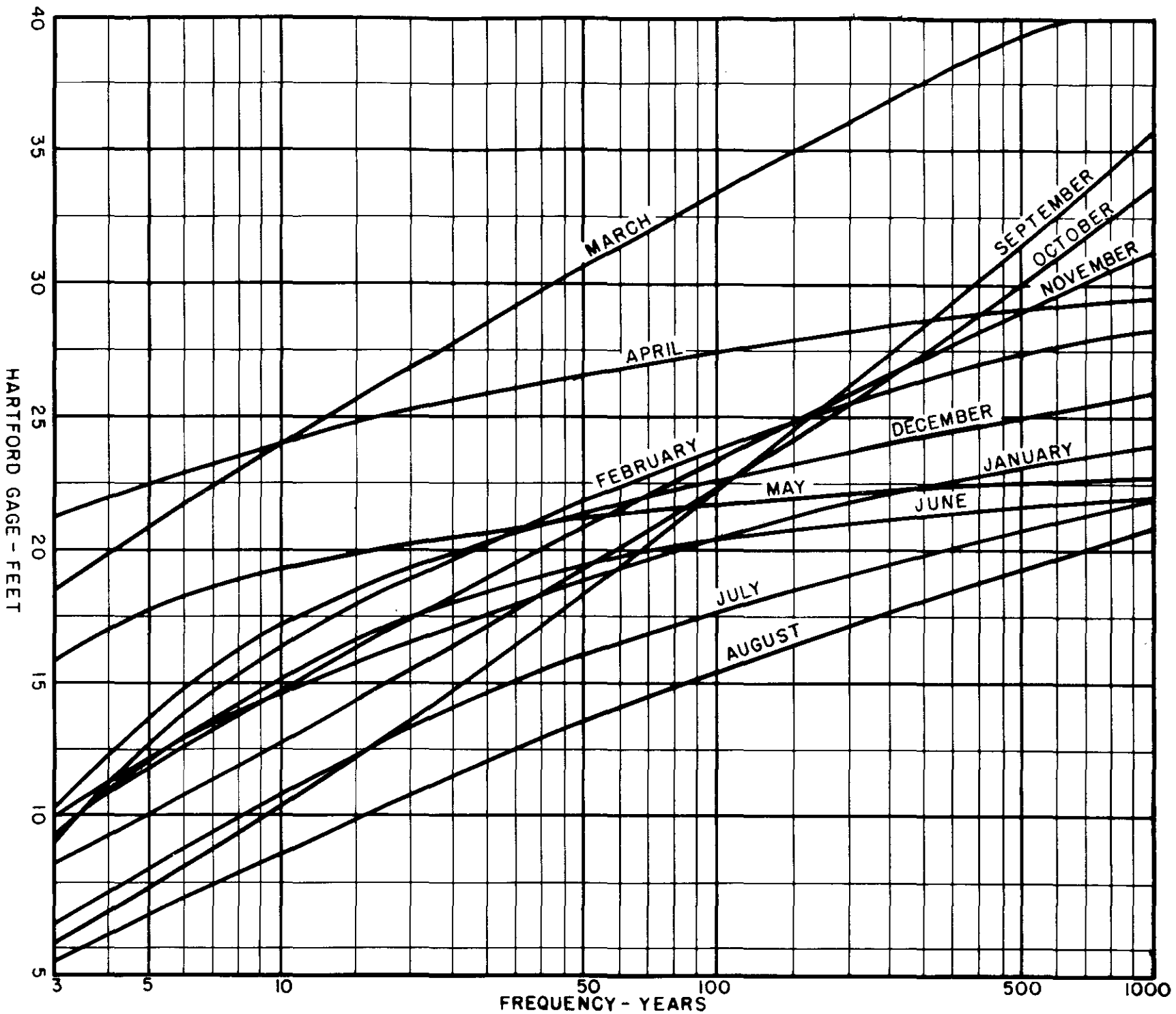


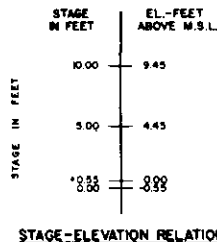
DIAGRAM SHOWING LIMITS OF SOIL CLASSES



CONNECTICUT RIVER FLOOD CONTROL
 RAINFALL INTENSITY—FREQUENCY CURVES
 1-HOUR STORM
 HARTFORD, CONNECTICUT
 35 YEARS OF RECORD — 1905 TO 1939 INCL.



CONNECTICUT RIVER
STAGE - FREQUENCY CURVES
HARTFORD, CONNECTICUT
ZERO HARTFORD GAGE = MINUS 0.55 M.S.L.



NOTES:
Low stages are subject to tidal fluctuation which has a mean amplitude 0 at a stage of 7 feet and 1.5 feet at a stage of 2 feet.
Stage readings on Hartford gage, zero--0.99 M.S.L.
Data supplied by U. S. Weather Bureau.
Gage located on downstream side of Memorial Bridge (Connecticut Backward).

CONNECTICUT RIVER FLOOD CONTROL
KEENEY LANE PUMPING STATION
HARTFORD, CONN.

HYDROGRAPH NO.

CONNECTICUT RIVER CONNECTICUT

NO OF SHEETS	SCALE	SHEET NO.
	AS SHOWN	

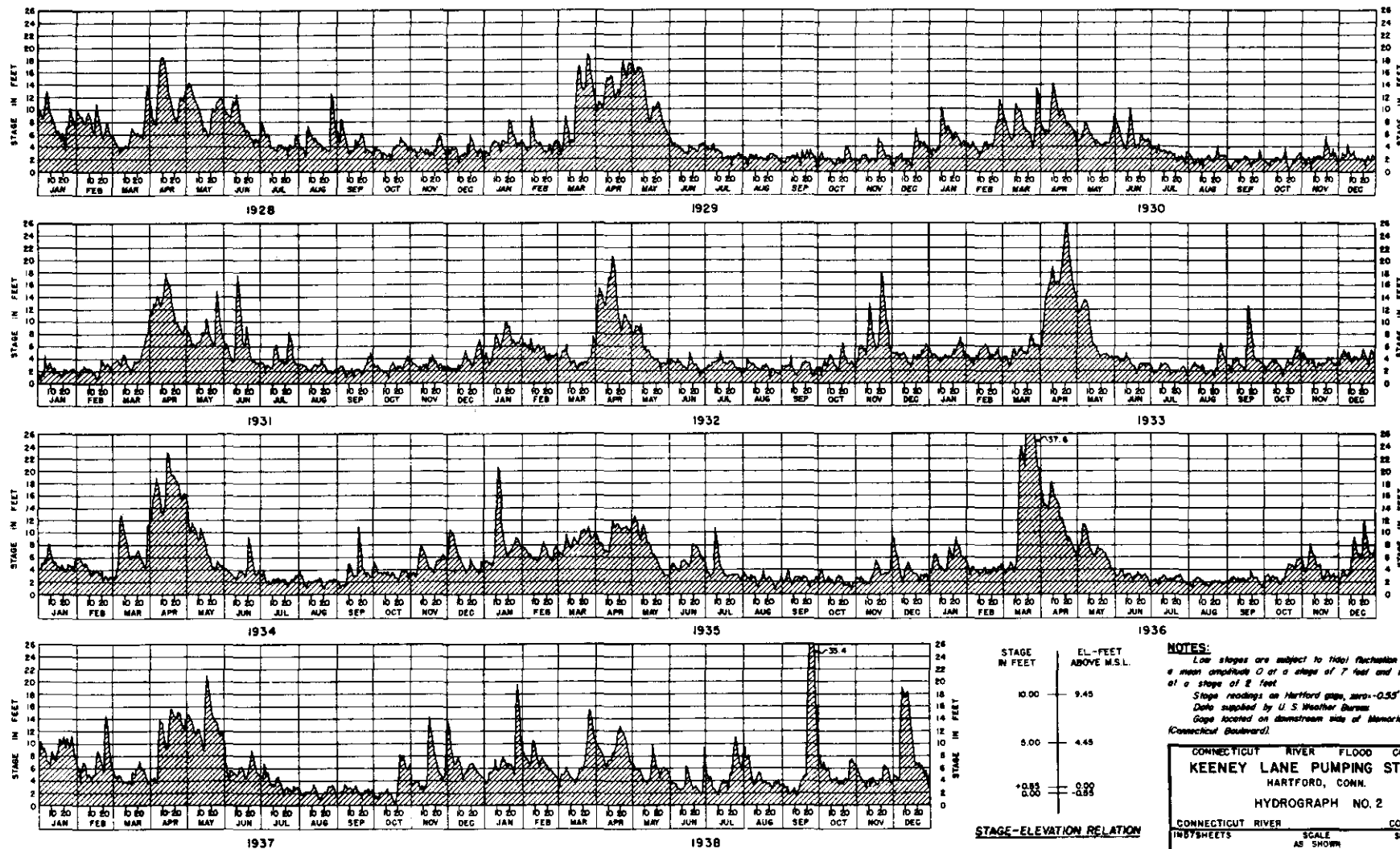
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944

 SENIOR ENGINEER HEAD, HYDRAULICS SECTION	 HEAD ENGINEER CHIEF, DIVISION OF CIVIL	 CHIEF OF BUREAU DISTRICT ENGINEER
PREPARED	DRAWN BY	CHECKED BY

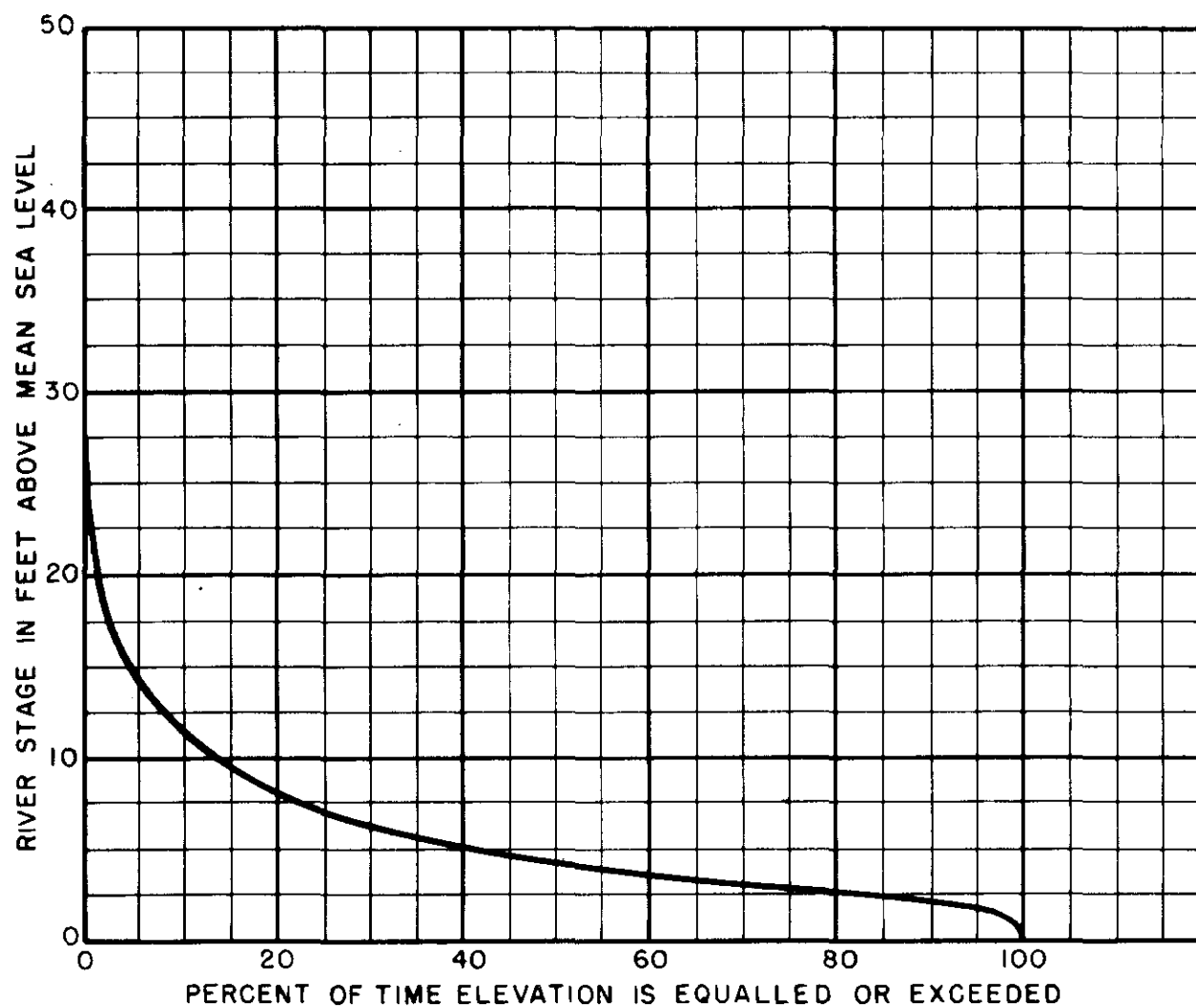
SEARCHED BY <i>[Signature]</i> INDEXED BY <i>[Signature]</i>	TRACED BY <i>[Signature]</i> CHECKED BY <i>[Signature]</i>	FILE NO. CT-3-122
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[illegible]

A OF D PLATE NO.8



KEY	DATE	REVISION	Checked by	REV. BY	CHK. BY	AP. BY

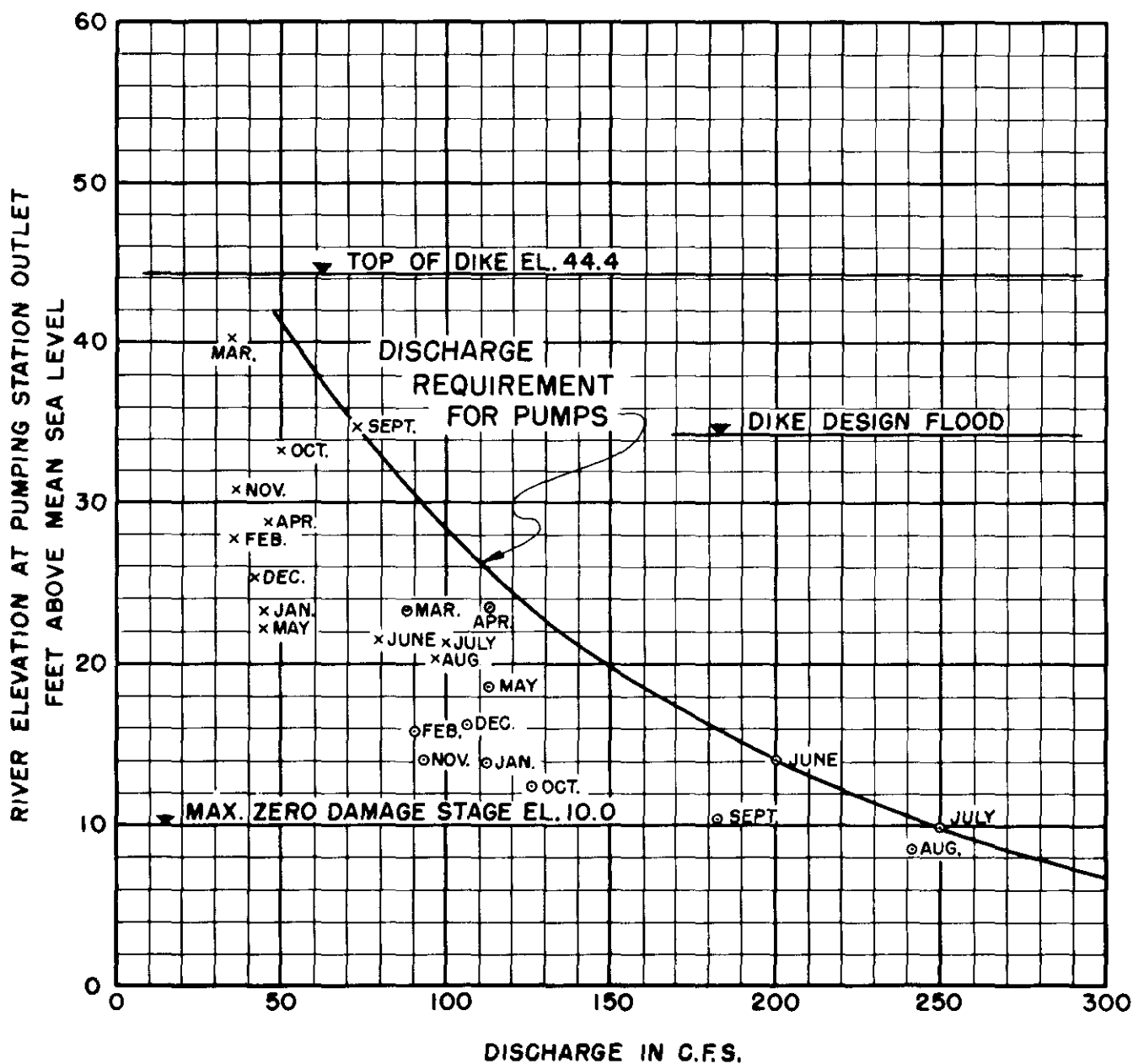


CONNECTICUT RIVER
STAGE—DURATION CURVE
AT
HARTFORD, CONN.

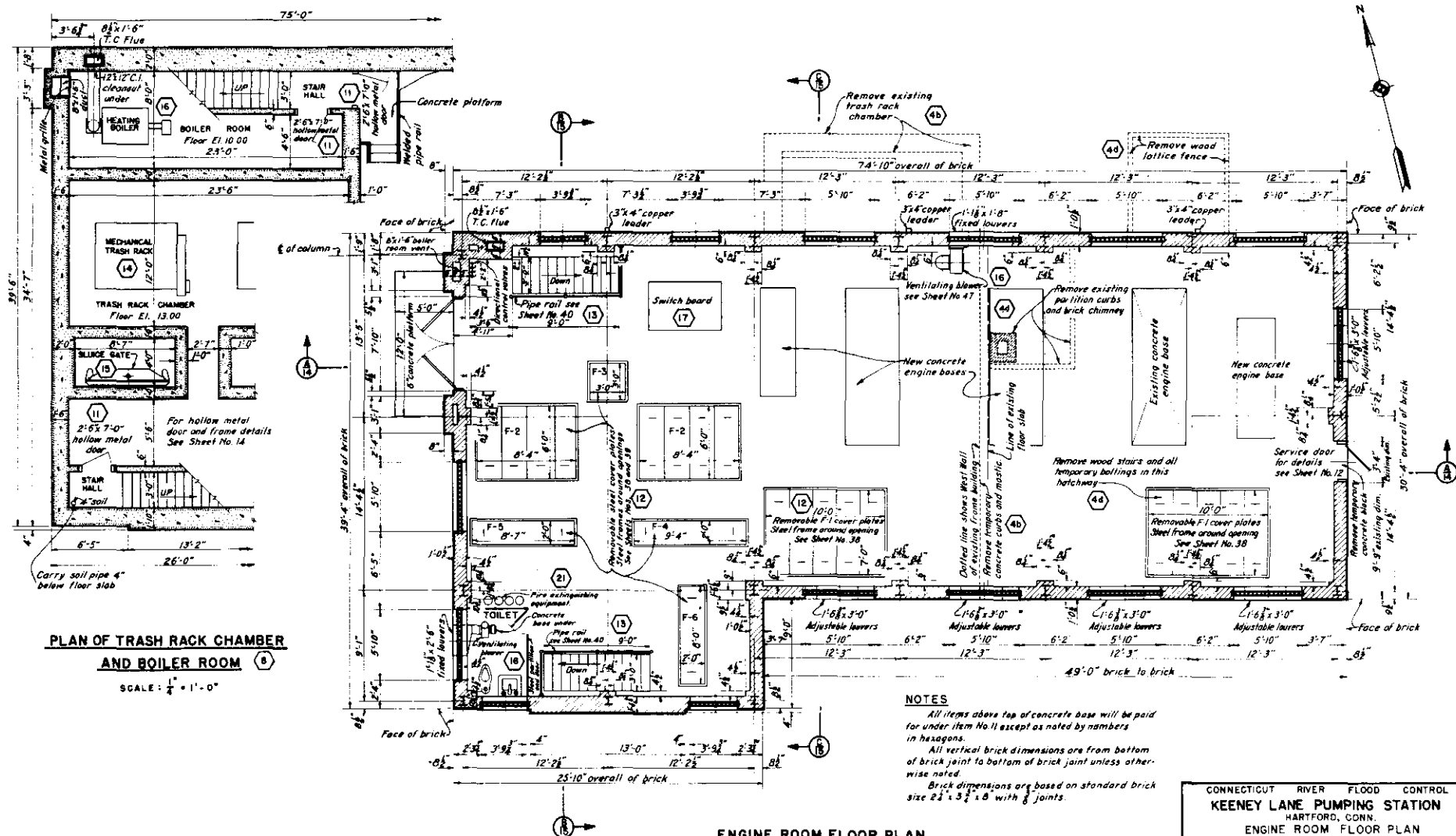
LEGEND:

○ 10-YR. RIVER STAGE VS. 10-YR. 1-HR. STORM

x 1000-YR. RIVER STAGE VS. 40% OF 10-YR. 1-HR. STORM



REQUIRED PUMP CAPACITY
KEENEY LANE PUMPING STATION



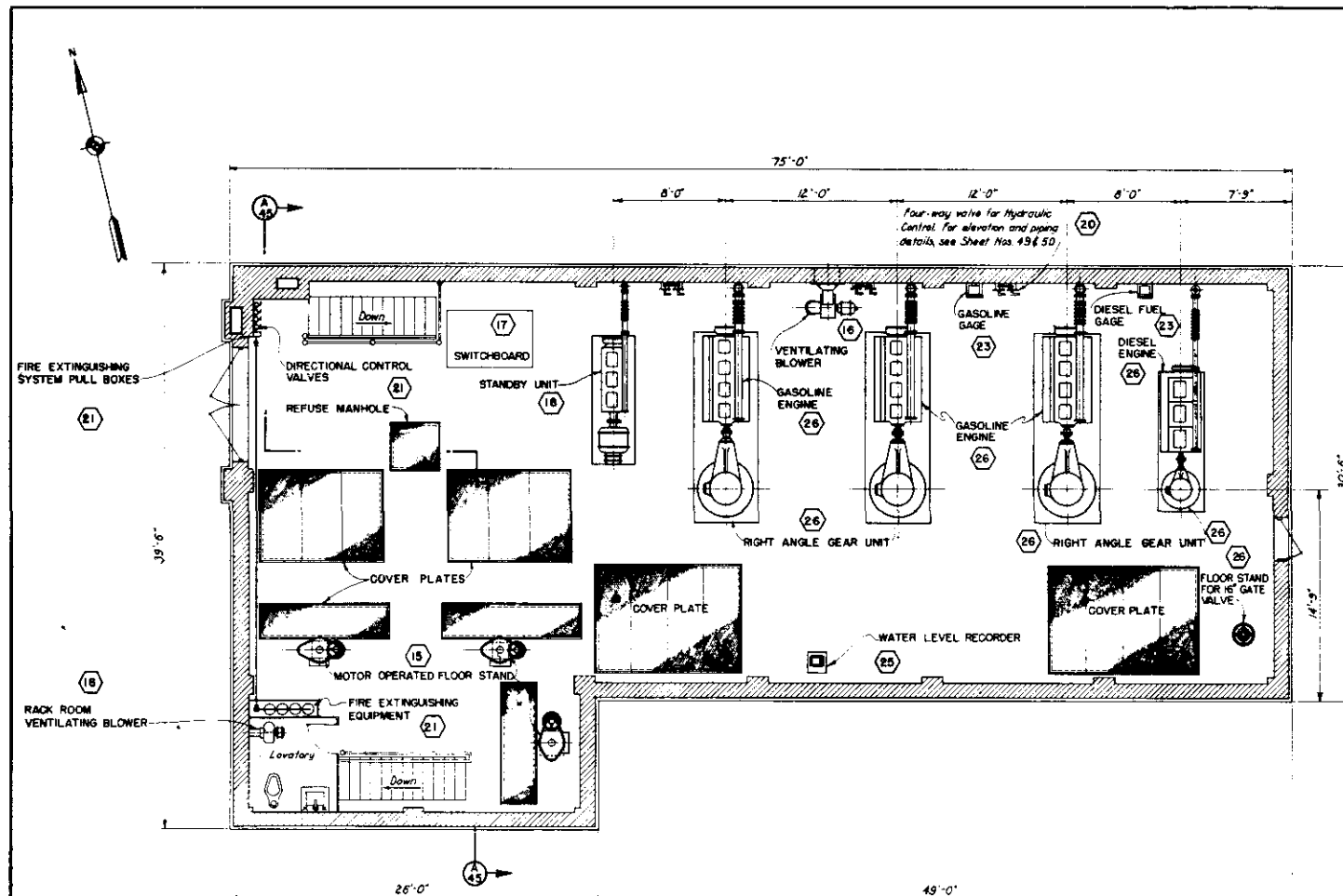
ENGINE ROOM FLOOR PLAN

SCALE: $\frac{1}{4}'' = 1'-0''$

KEY	DATE	REVISION	Indicated by	REV BY	CHK BY

CONNECTICUT RIVER FLOOD CONTROL	
KEENEY LANE PUMPING STATION	
HARTFORD, CONN.	
ENGINE ROOM FLOOR PLAN	
ARCHITECTURAL	
CONNECTICUT RIVER	CONNECTICUT
IN 37 SHEETS	SHEET NO. 8
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944	
DESIGNED BY	APPROVED BY
DRAWN BY	CHECKED BY
FILE NO. CT-4-3222	





ENGINE ROOM PLAN

SCALE $\frac{1}{4}$ " = 1'-0"

NOTES

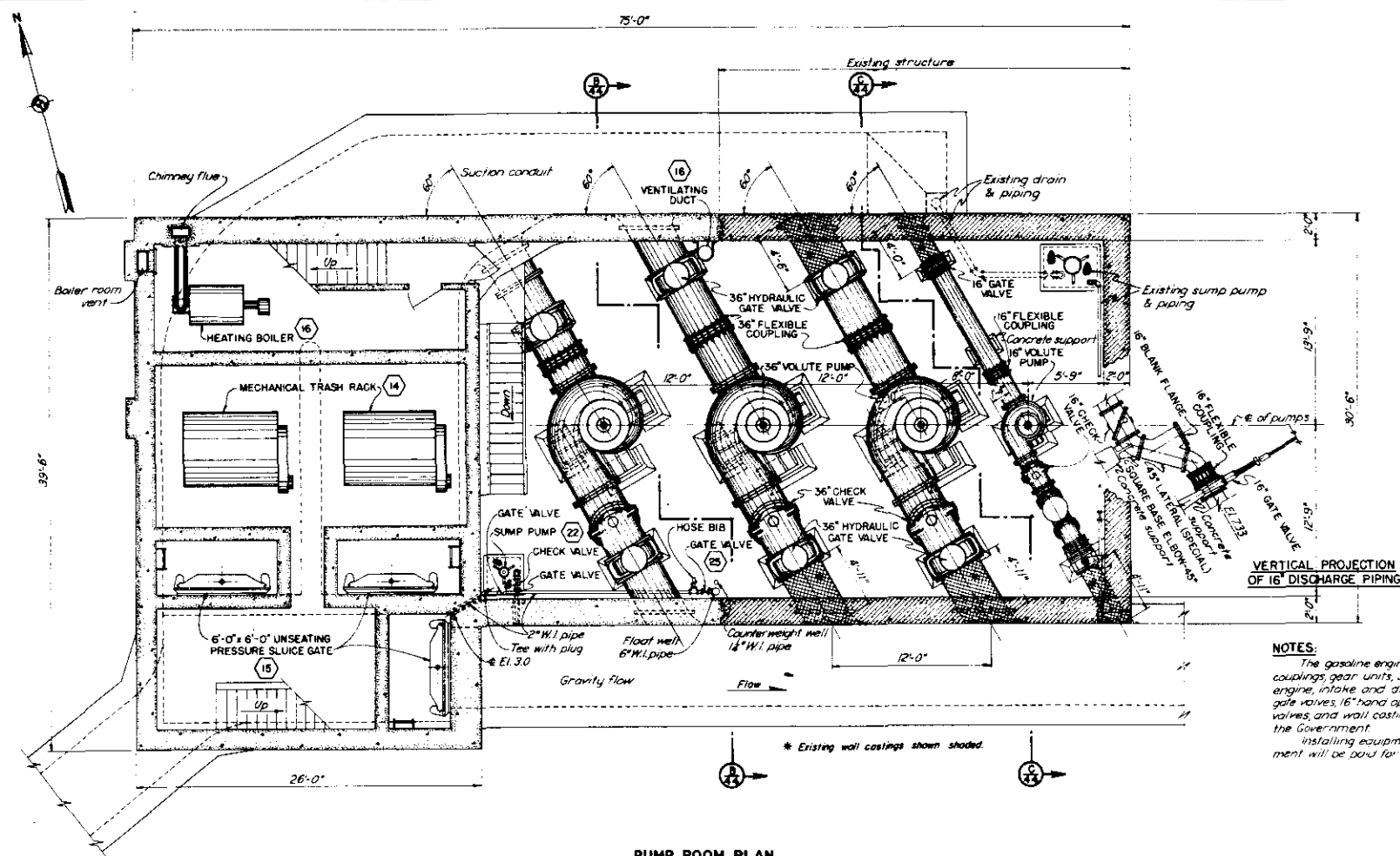
The gasoline engines, Diesel engine, exhaust piping and silencers for pump engines, gear units, couplings, intake and discharge piping, 36" hydraulic operated gate valves, 16" hand operated gate valves, check valves and wall castings, will be furnished by the government.

Installing equipment furnished by the government will be paid for under item No. 26.

A OF D PLATE NO. 14

CONNECTICUT RIVER FLOOD CONTROL	
KEENEY LANE PUMPING STATION	
HARTFORD, CONNECTICUT	
GENERAL ARRANGEMENT OF EQUIPMENT NO. 1	
CONNECTICUT RIVER	CONNECTICUT
IN 37 SHEETS	SHEET NO. 48
SCALE 1/4" = 1'-0"	
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE 1944	
DESIGNED BY: [Signature]	
CHECKED BY: [Signature]	
APPROVED BY: [Signature]	
FILE NO. CT-4-3286	

KEY	DATE	REVISION (Initialed by)	REV. BY	CHK. BY	AP. BY



NOTES:
The gasoline engines, exhaust piping, silencers, couplings, gear units, 36" pumps, 16" pump, Diesel engine, intake and discharge piping, 36" hydraulic gate valves, 16" hand operated gate valves, check valves, and wall castings will be furnished by the Government.
Installing equipment furnished by the government will be paid for under Item No 26

* Existing wall castings shown shaded

A OF D PLATE NO.15

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP.
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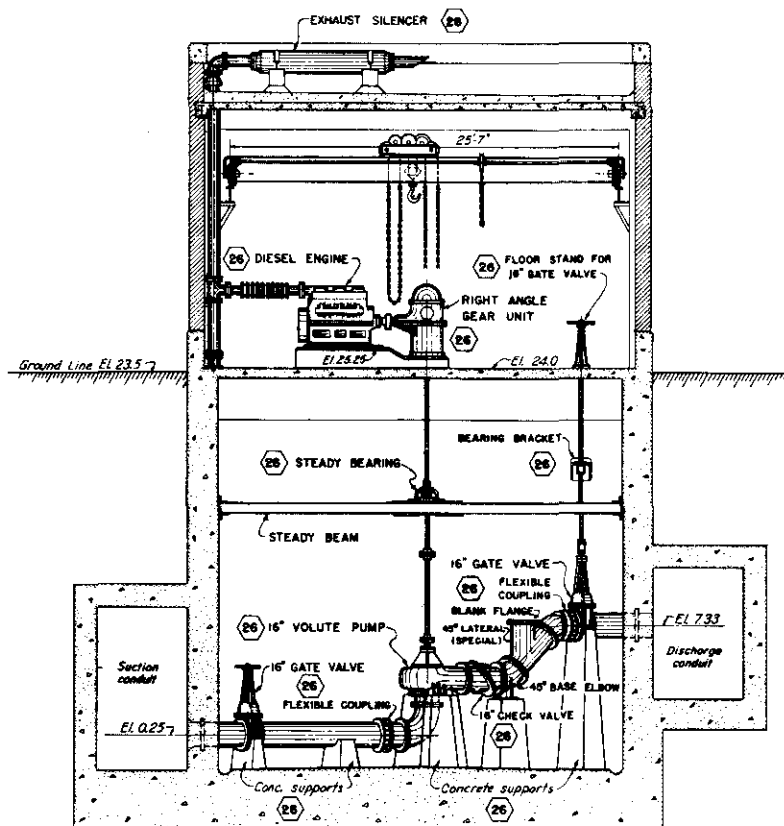
CONNECTICUT RIVER FLOOD CONTROL
KEENEY LANE PUMPING STATION
HARTFORD, CONN.
GENERAL ARRANGEMENT OF EQUIPMENT NO. 2

CONNECTICUT RIVER CONNECTICUT
IN 57 SHEETS SCALE 1/4 IN = 1 FT SHEET NO. 43

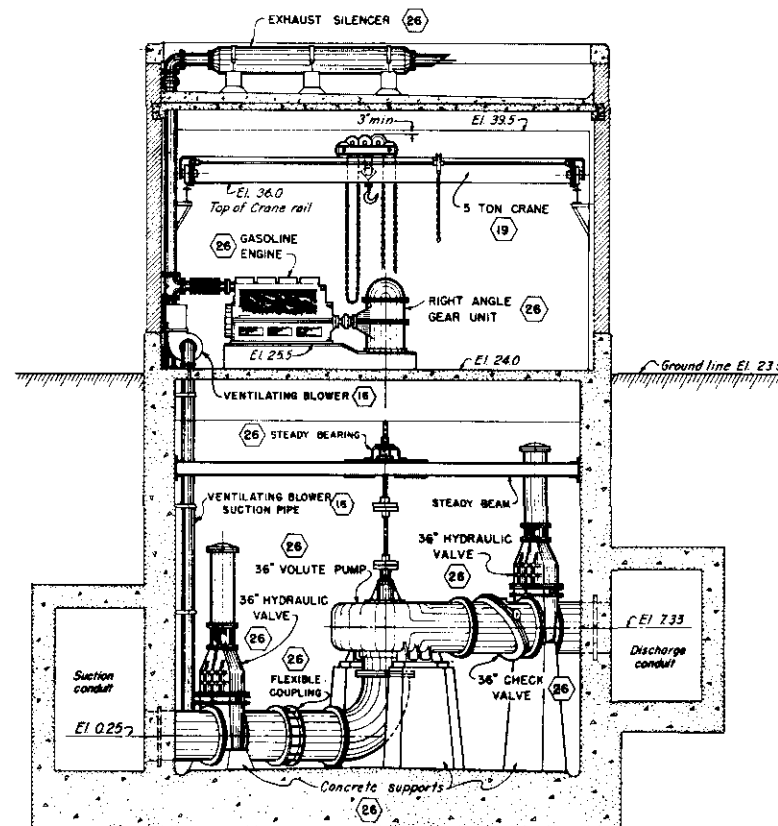
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., JUNE 1944

SUBMITTED APPROVED AND FORWARDED APPROVED
BY SPECIAL AGENT IN CHARGE SPECIAL AGENT IN CHARGE
FOR THE DISTRICT HEAD ENGINEER DISTRICT ENGINEER
DISTRICT OFFICE DISTRICT OFFICE DISTRICT OFFICE

FILE NO. CT. 4-3257



SECTION A
SCALE: $\frac{1}{4}'' = 1'-0''$



SECTION B
SCALE: $\frac{1}{4}'' = 1'-0''$

NOTES

The gasoline engines, Diesel engine, exhaust piping and silencers for pump engines, gear units, couplings, intake and discharge piping, 36" hydraulic operated gate valves, 16" hand operated gate valves, check valves and wall castings, will be furnished by the government.
Installing equipment furnished by the government will be paid for under Item No. 26.
Furnishing and installing traveling crane will be paid for under Item No. 19.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CHK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
KEENEY LANE PUMPING STATION

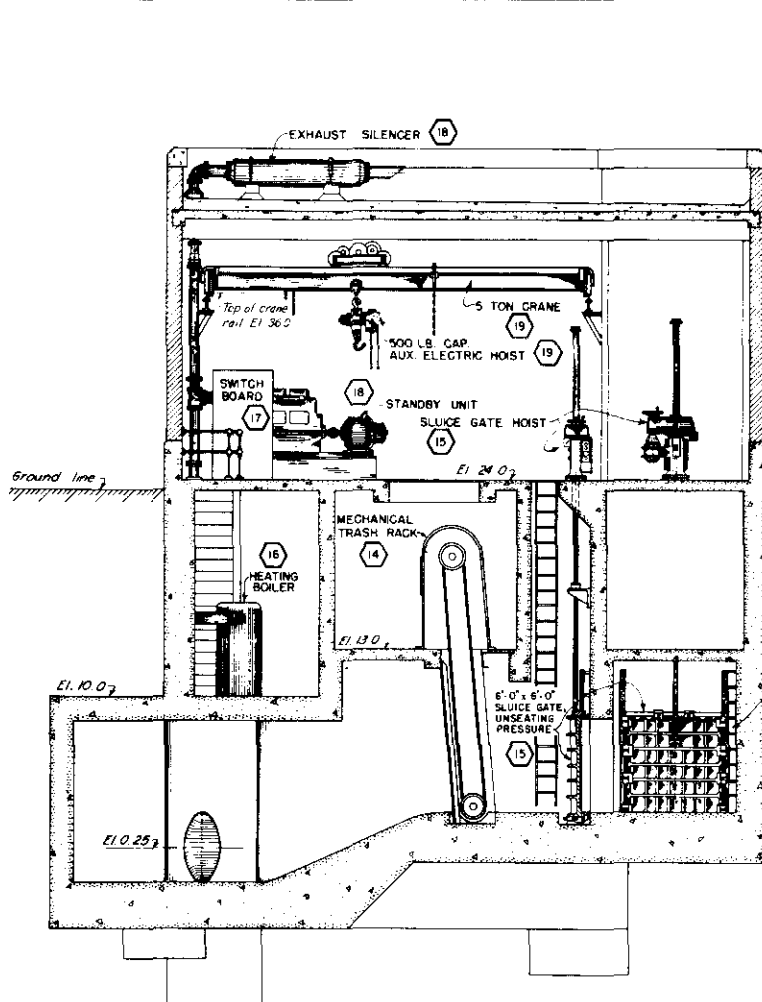
GENERAL ARRANGEMENT OF EQUIPMENT NO. 3

CONNECTICUT RIVER CONNECTICUT
IN 57 SHEETS SCALE: 1/4" = 1'-0" SHEET NO. 44

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. JUNE 1944

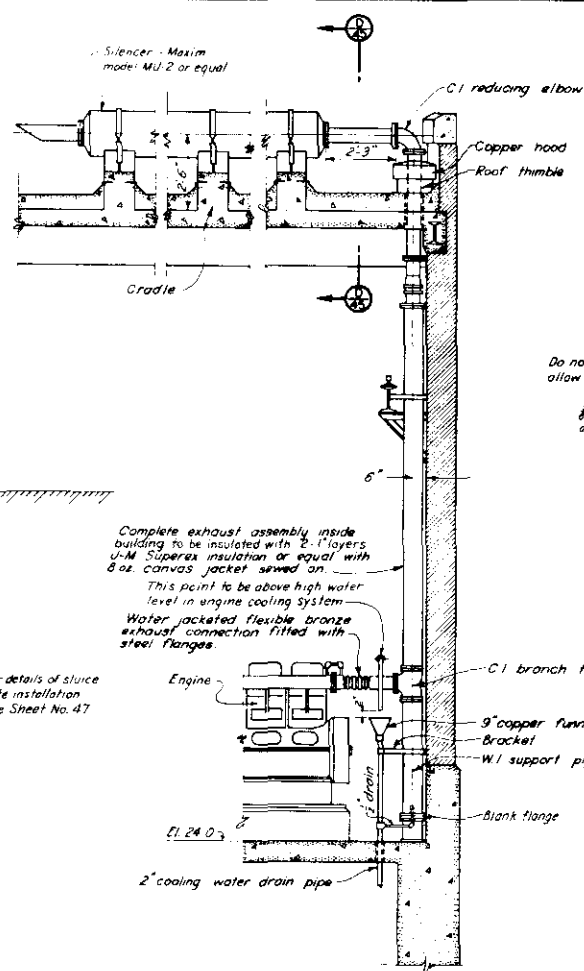
DESIGNED BY	CHECKED BY	APPROVED BY

FILE NO. CT-4-3858

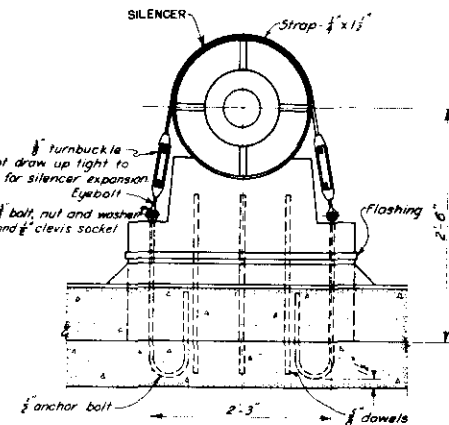


SECTION A
42

SCALE 1/4" = 1'-0"



TYPICAL SECTION SHOWING
ENGINE EXHAUST PIPING

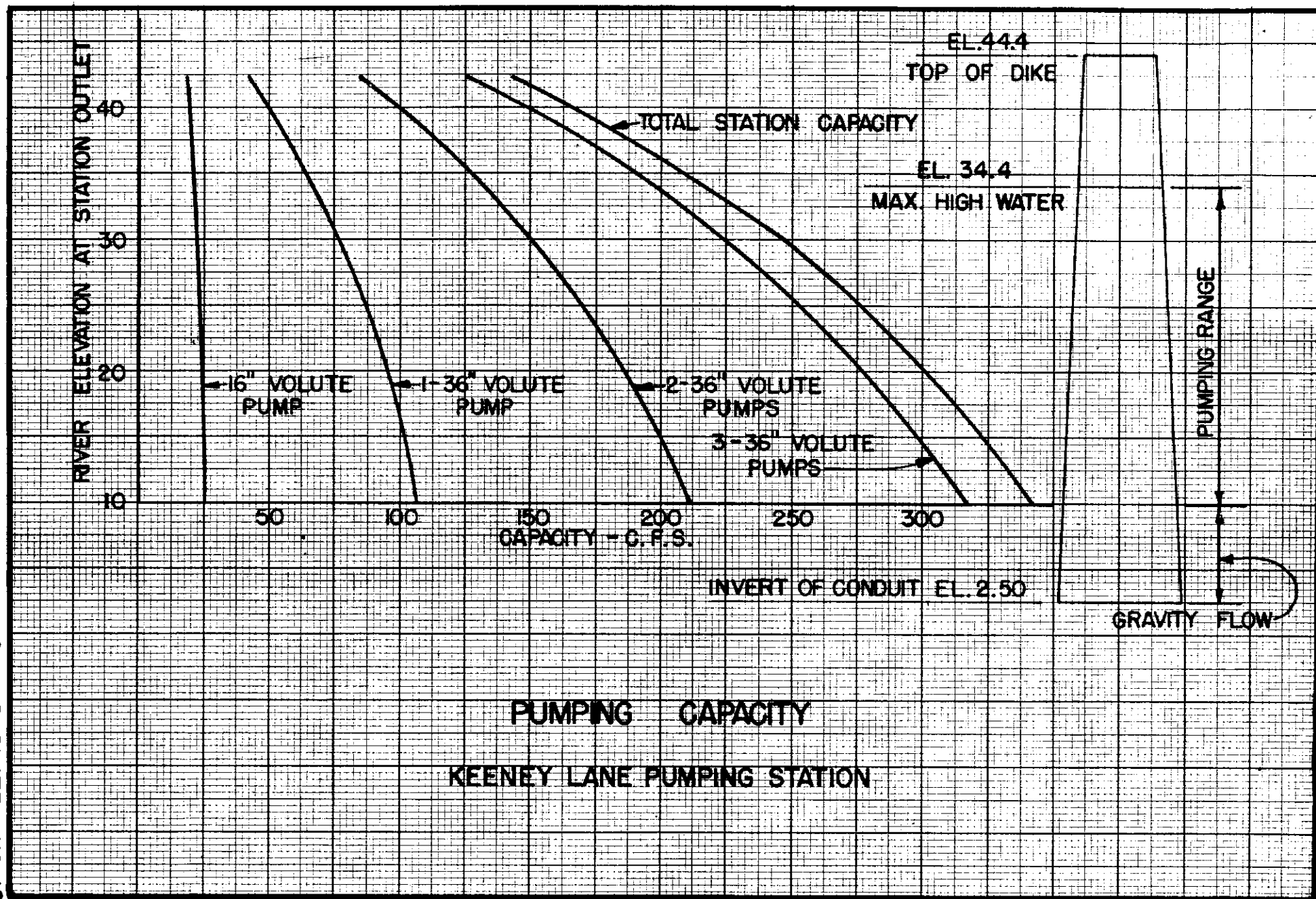


SECTION D
45

SCALE 1/2" = 1'-0"

NOTES
Furnishing and installing insulation on exhaust assembly for pump engines, will be paid for under Item No. 26.
Furnishing and installing insulation on exhaust assembly for standby-unit engine, will be paid for under Item No. 18.

CONNECTICUT RIVER FLOOD CONTROL	
KEENEY LANE PUMPING STATION	
HARTFORD, CONN.	
GENERAL ARRANGEMENT OF EQUIPMENT NO. 4	
CONNECTICUT RIVER	CONNECTICUT
IN 57 SHEETS	SHEET NO. 45
U.S. ENGINEER OFFICE, PROVIDENCE, R.I.	JUNE 1944
DESIGNED BY	APPROVED BY
CHECKED BY	APPROVED BY
REVISION	FILE NO. CE-4-3259



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EXECUTIVE OFFICER

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PUMPING STATION
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A. H. DAVISON

ENGINEER (CIVIL), P-5

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(Maint & Oper. of Reservoirs
Inspection of Dikes)

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DAMTENDER (F.C.), CPC-8

BIRCH HILL DAM

L. P. VIGNEAULT

DAMTENDER (F.C.), CPC-8

SURRY MT. DAM

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U.S. ENGINEER OFFICE, PROVIDENCE, R. I.

JULY, 1944